VOL. 6 NO. 19
October 15, 1981

Energy Research Abstracts

ABSTRACTS 28028-29764

Technical Information Center
UNITED STATES DEPARTMENT OF ENERGY

CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications which are comprehensive in their coverage of certain energy fields are issued regularly. All information in these publications, plus additional backup information, is included in the energy data base of the Technical Information Center; all references are also available for machine searching via the on-line retrieval system, DOE/RECON. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below.

PUBLICATIONS OF THE TECHNICAL INFORMATION CENTER

Energy Abstracts for Policy Analysis (EAPA)

A monthly abstract journal devoted to the analysis of energy research, conservation, and policy. Scope and coverage are limited to substantive articles or reports and emphasize the following: programmatic efforts; legislative, regulatory, and other legal aspects; social, economic, and environmental impacts; regional and sectoral analyses; institutional factors, etc. *EAPA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402; domestic subscribers $4.00, foreign $5.00 per copy; annual cumulative index, domestic $6.00, foreign $7.50 per copy. The annual subscription price is $44.00 for domestic subscribers and $55.00 for foreign subscribers.

Energy Research Abstracts (ERA)

A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. Indexes are cumulated semiannually and annually. *ERA* is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues including a semiannual index and an annual index is $184.00 for domestic subscribers and $230.00 for foreign subscribers. The semiannual and annual indexes will also be available separately to subscribers. The cost for the semiannual index is $18.00 (domestic) or $22.50 (foreign); the annual index is $33.00 (domestic) or $41.25 (foreign). A single issue costs $5.55 (domestic) or $6.95 (foreign).

The following publications are available to the public on a subscription basis from the National Technical Information Service (NTIS), Springfield, Virginia 22161. The annual subscription rate for one volume (calendar) year (12 issues plus cumulative index) is $45.00 for domestic subscribers and $90.00 for subscribers outside the North American Continent. A single issue is $6.00 (domestic) and $12.00 (outside the North American Continent).

Current Energy Patents (CEP)

A monthly publication providing abstracting and indexing coverage of the international patent literature, including patent applications, that concerns any aspect of energy production, conservation, and utilization. Available as PB81-902800.

Energy Conservation Update (ECU)

A monthly abstract journal devoted to current information on energy conservation in buildings, transportation and propulsion, and industry; waste processing plants and equipment; energy storage; energy conversion; advanced automotive systems; combustion systems; power cycles; synthetic fuels; and power transmission. Available as PB81-914800.

Energy and the Environment (EAE)

A monthly abstract journal devoted to information on the impacts of energy-related activities and radioactive and nonradioactive pollutants on the environment. Available as PB81-914900.

Fossil Energy Update (FEU)

A monthly abstract journal devoted to information on the processing and use of fossil fuels. Available as PB81-914600.

Fusion Energy Update (CFU)

A monthly abstract journal devoted to information on controlled thermonuclear research. Available as PB81-915300.

Geothermal Energy Update (GEU)

A monthly abstract journal devoted to information on the exploration and development of geothermal resources. Available as PB81-914700.

Solar Energy Update (SEU)

A monthly abstract journal devoted to information on the utilization of solar, tidal, and wind energy. Available as PB81-914500.

Synthetic Fuels Update (SFU)

A monthly abstract journal devoted to information on coal gasification; coal liquefaction; other coal processing; biomass conversion to fuel; shale oil and tar sand bitumen production; hydrogen fuels; other hydrocarbon fuels; alcohol fuels; and inorganic hydrogen compound fuels. Available as PB81-902700.

INTERNATIONAL ENERGY PUBLICATIONS

Atomindex (Published in cooperation with the Technical Information Center by the International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria)

A semimonthly abstract journal devoted to information on nuclear science and technology. Through an exchange agreement, IAEA/INIS provides all non-U. S. nuclear information of *Atomindex* to TIC for inclusion in the DOE/RECON Data Base; in turn, TIC provides all U. S. nuclear information to IAEA/INIS for inclusion in *Atomindex*. *Atomindex* is available by subscription from UNIPUB, 345 Park Avenue South, New York, NY 10010. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $290.

Coal Abstracts (Published in cooperation with the Technical Information Center by the International Energy Agency, IEA Coal Research, London, England)

A monthly abstract journal devoted to information on coal. Through an exchange agreement, IEA Coal Research provides all non-U. S. coal information of *Coal Abstracts* to TIC for inclusion in the DOE/RECON Data Base; in turn, TIC provides all U. S. coal information to IEA Coal Research for inclusion in *Coal Abstracts*. *Coal Abstracts* is available to Department of Energy components and contractors from the Technical Information Center. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 100 pounds sterling per year.

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Editor's Note

Printed cumulative indexes will be prepared for *Energy Research Abstracts (ERA)*, Volume 6 for 1981. The Volume 7, 1982 subscription will provide the 24 semi-monthly issues only. No printed cumulative indexes will be prepared for *ERA*, Volume 7, 1982. For those not making use of one or more of the on-line systems, TIC expects to make available a microfiche version of *ERA* annual indexes for Volume 7. Sources and prices for these microfiche will be announced at a later date.

With Volume 7, the coverage of *Energy Research Abstracts* will be broadened to announce all unclassified, publicly available reports processed by the Technical Information Center. This coverage increase will result in the inclusion of 10,000 additional abstracts. Discontinuance of the cumulative indexes will offset the cost of this additional coverage.

The total content of *ERA* is maintained on a continuing basis in the Energy Data Base (EDB). EDB is available for searching via the DOE/RECON on-line system and is also available commercially via Bibliographic Retrieval Service (BRS). Commercial availability via Dialog and Orbit will be added in the fall. This widespread availability of constantly cumulating indexes to *ERA* information decreases the usefulness of printed cumulative indexes to an impractical level.

The editorial staff believes its decision to rely on computerized systems for retrospective searching is both forward thinking and cost-effective. It is expected that any inconvenience to *ERA* users will be minimal.

Dave E. Bost

energinfo ERA

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ENERGY RESEARCH ABSTRACTS

ABOUT THE TECHNICAL INFORMATION CENTER

The Technical Information Center, as the national information center for the Department of Energy, manages, publishes, and disseminates scientific, technical, and practical energy information acquired from worldwide sources. It builds and maintains energy information data bases used to prepare abstracting journals, bibliographies, and literature searches. The data bases are also searchable via the Department's on-line retrieval system, DOE/RECON. This information is provided to DOE program offices and contractors; scientists; engineers; educational, commercial, and industrial communities; and the general public. The Technical Information Center conducts an active announcement and marketing program. It establishes policy and administers control of an inventory and registry for DOE publications. The Center also develops and evaluates new and effective information systems and services as required by scientific and technical management within the Department of Energy.

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ABOUT *ENERGY RESEARCH ABSTRACTS*

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers, and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, conservation, safety, environmental impacts, and regulation.

ERA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Federal, state, and municipal agencies concerned with energy development, conservation, and usage may obtain *ERA* free of charge. Inquiries should be directed to the Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

ERA is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues including a semiannual index and an annual index is $184.00 for domestic subscribers and $230.00 for foreign subscribers. The semiannual and annual indexes are also available separately to subscribers. The cost for the semiannual index is $18.00 (domestic) or $22.50 (foreign); the annual index is $33.00 (domestic) or $41.25 (foreign). A single issue costs $5.55 (domestic) or $6.95 (foreign).

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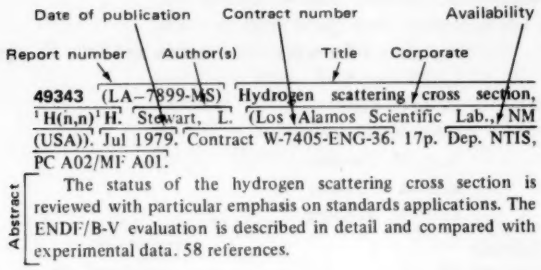
• ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

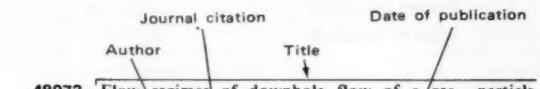
The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.



49343 (LA–7899-MS) **Hydrogen scattering cross section, $^{1}H(n,n)^{1}H$.** Stewart, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.

Abstract

The status of the hydrogen scattering cross section is reviewed with particular emphasis on standards applications. The ENDF/B-V evaluation is described in detail and compared with experimental data. 58 references.



48072 Flow regimes of downhole flow of a gas—particle mixture. Stokes, V.K. (Foster-Miller Associates, Inc., Waltham, MA). *J. Fluids Eng.*; 100: No. 4, 410-413 (Dec 1978).

Abstract

Assuming that a gas—particle mixture behaves like a homogeneous gas, in which the slip velocity of the particles is negligible, the various flow regimes in one-dimensional downhole flow, including the effects of gravity, compressiblity and wall friction, have been investigated. It is assumed that the flow is isothermal and that the wall shear can be accounted for by an empirically determined friction factor.

• INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. These indexes are cumulated semiannually and annually. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

49343 (LA–7899-MS) Hydrogen scattering cross section, $^{1}H(n,n)^{1}H$. Stewart, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.

is indexed as:

Los Alamos Scientific Lab., NM (USA)
Advanced laser fusion target fabrication research and development proposal, 4:48249 (LA–7619-P)
Hydrogen scattering cross section, $^{1}H(n,n)^{1}H$, 4:49343 (LA–7899-MS)

• Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Stewart, L., Hydrogen scattering cross section, $^{1}H(n,n)^{1}H$, 4:49343 (LA–7899-MS)
Stewart, M.D., *See* McInroy, J.F., 4:49280
Stewart, W., *See* Dean, J.W., 4:48543
Stimson, J., Reproduction, growth, and survival of Enewetak corals, 4:49200 (NVO–0703-1, pp 56-59)

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles and informative phrases, or both, specific to these entries are arranged alphabetically under the entries.

HYDROGEN I TARGET
Neutron Reactions
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HYDROLOGY
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Inventory of advanced energy technologies and energy conservation research and development: 1976-1978. Volume II. Prepared for the Committee on Science and Technology, U.S. House of Representatives, 96*th* Congress, 4:48749.

• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

W-7405-ENG-36	**Los Alamos Scientific Lab., NM (USA)**	
	3:49698	LA-tr–78-45
	3:49857	LA–7224T
	3:49863	LA–7235-MS
W-7405-ENG-48	**California Univ., Livermore (USA). Lawrence Livermore Lab.**	
	3:49386	UCRL–52456
	3:49431	UCRL–52405

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience.

LA-7899-MS	**4:49343**	**Dep. NTIS, PC A02/MF A01**
LA-tr-78-69	**4:48158**	**Dep. NTIS, PC A03/MF A01**

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Communication concerning the editorial policy and content of *Energy Research Abstracts* should be addressed to the Editor, *Energy Research Abstracts*, Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts.* The following listing includes the totality of the 40 first-level and 294 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope notes is available as DOE/TIC-4584-R4 from NTIS for $7.00.

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SUBJECT CONTENTS (ALPHABETICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 294 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope notes is available as DOE/TIC-4584-R4 from NTIS for $7.00.

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28028 (CONF-810498—(Vol.1), pp 290-308) **Utilization of advanced coal processing technology in the preparation of coal-oil mixtures.** Siemssen, J.O.; Yoo, J.S.; Nowak, A.V. (ARCO Petroleum Products Co., Harvey, IL). 1981. NTIS, PC A20/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

A major US market for coal-oil mixtures is in the Eastern United States. The coal from Northern and Central Appalachia which is available to this market is generally above 1% sulfur and 8% ash. The use of this coal in a coal-oil mixture in boilers originally designed to burn oil may require cleaning of the coal for both operating and environmental reasons. Atlantic Richfield Company has developed a cost-effective technology which will remove up to 90% of the pyritic sulfur and 60 to 80% of the ash forming minerals from bituminous coals with a 95% heating value recovery. In addition to providing a lower sulfur and lower ash product, the process generally improves the slagging and fouling characteristics of these coals. The use of the processed coal in COM has been investigated and found to produce a high quality product. In addition to the benefits due to the reduction in sulfur and ash levels and improvement in ash properties, the resulting COM has been found to have improved stability characteristics. All of these factors help to optimize the overall system performance and increase the probability that COM can be substituted for oil in an existing boiler.

28029 (DOE/ET/10104—5(Vol.1)) **Solvent Refined Coal (SRC) Process. Quarterly technical progress report, April 1980-June 1980.** (Pittsburg and Midway Coal Mining Co., Kansas City, MO (USA); Pittsburg and Midway Coal Mining Co., Englewood, CO (USA)). Apr 1981. Contract AC05-76ET10104. 244p. NTIS, PC A11/MF A01. Order Number DE81025173.

This report summarizes the progress of the Solvent Refined Coal (SRC) project by The Pittsburg and Midway Coal Mining Co. under contract with the Department of Energy. The Fort Lewis Pilot Plant continued to operate in the SRC-II mode processing Powhatan No. 6 Mine coal until April 27. In the SRC-II Preheater B test program, two baseline runs and five slurry runs were completed as a part of the high heat flux run series. After a scheduled three week shutdown, the plant resumed operation May 24 in the SRC-I mode. The SRC-I Preheater B test program began June 1 and fourteen baseline runs and eight slurry runs were completed. This test program was temporarily suspended June 26 because of coil skin thermocouple problems. Work achieved on Process Development Unit P-99 this period included completion of a study to determine the effect of L/D ratio on yields. In addition, three runs (P99-67, -68, -69) were made feeding Powhatan No. 6 Mine coal, and two runs (P99-70 and -71) were made feeding Ireland Mine coal. Research and development technical support services accomplished are as follows. Modeling and simulation studies have addressed the areas of temperature gain in a SRC-II reactor, the recycle system, application of the steady state CSTR thermal response model, and development of a comprehensive model for coal liquefaction in SRC-II mode. Work was initiated on a process cost model of a commercial SRC-II plant which will be used for optimization studies and for guiding R and D projects. Several process parameters have been investigated using pressure differential scanning calorimetric/thermogravimetric techniques to study coking tendencies of SRC-II streams.

28030 (DOE/ET/10104—5(Vol.2)) **Solvent Refined Coal (SRC) Process. Quarterly technical progress report, April 1980-June 1980.** (Pittsburg and Midway Coal Mining Co., Kansas City, MO (USA); Pittsburg and Midway Coal Mining Co., Englewood, CO (USA)). Apr 1981. Contract AC05-76ET10104. 328p. NTIS, PC A15/MF A01. Order Number DE81026324.

An estimate of the temperature gain, defined as the change in the reactor outlet temperature for a given change in inlet temperature made with the simplified CSTR model, indicates that the gain is about 4 for both P-99 and the demonstration plant. The estimate of gain is independent of reactor scale, and the value of gain agrees with the gains observed using the more comprehensive partially backmixed reactor model. The value of gain indicates a high level of sensitivity (coupling) between inlet and outlet temperatures. The CSTR model can be used in conjunction with data from the pilot plant to estimate the activation energy (E) for the point rate of hydrogen consumption, a key kinetics parameter which determines the gain. The value of E used in the model (18.8 kcal/gmole) was obtained from curve fits to pilot plant and CSTR data and is reasonable for this type of hydrogenolysis process. Some additional implications are: (1) The predicted temperature response profile shows that, in the absence of quench control, should the average temperature increase, it will continue to increase to a high temperature eventually reaching beyond the range of the model. Similarly, should conditions cause the temperature to drop, it would continue to drop until a lower stable steady state around 788°F is reached. This lower steady state, one of low reactivity, is within the validity of the model. (2) A separate analysis not presented here indicates that the order of the hydrogen partial pressure dependence in the reaction rate also influences the stability, multiplicity, and gain at the steady state. This behavior was discussed in an earlier report.

28031 (DOE/ET/10104—T14) **Solvent Refined Coal (SRC) process. Annual technical progress report, January-December 1978.** (Pittsburg and Midway Coal Mining Co., Kansas City, MO (USA); Pittsburg and Midway Coal Mining Co., Denver, CO (USA)). Jul 1981. Contract AC05-76ET10104. 249p. (FE—496-170). NTIS, PC A11/MF A01. Order Number DE81026662.

This report summarizes the progress of the Solvent Refined Coal (SRC) Project by The Pittsburgh and Midway Coal Mining Co. for the Department of Energy for the period January 1, 1978 to December 31, 1978. The fourth quarter of 1978 is reported here in detail. Activities included the operation and modifications of the Solvent Refined Coal Pilot Plant at Fort Lewis, Washington, the Process Development Unit P-99 at Harmarville, PA, and the research at Merriam Laboratories in Merriam, KS. Following a turnaround, the pilot plant processed Pittsburgh Seam coal in the SRC-II mode of operation during seven material balance runs. At Hamarville, P-99 evaluated thirteen different run conditions with Pittsburgh Seam coal. Merriam investigations included a study of long residence time SRC-I operations with Pittsburgh Seam coal; a series of runs to determine the effect of feed slurry composition, hydrogen feed rate, and coal source on SRC-II processing of Powhatan coal; and a preliminary investigation of SRC-I operation with short residence time. An analytical evaluation with burner studies of SRC-II liquids was also completed in this period.

28032 **(DOE/ET/10154—T12) Solvent refined coal (SRC) process operation of solvent-refined coal pilot plant, Wilsonville, Alabama. Quarterly technical progress report, July-September 1980.** Lewis, H.E. (Catalytic, Inc., Wilsonville, AL (USA)). Jun 1981. Contract AC01-76ET10154. 147p. (FE—2270-78). NTIS, PC A07/MF A01. Order Number DE81027215.

This report summarizes the operating data and test results obtained at the 6 ton per day solvent refined coal (SRC) pilot plant in Wilsonville, Alabama for the third quarter of 1980. Kentucky 9 coal from the Fies mine was processed during the early part of the period (Runs 211 and 212) and again later in the period (Runs 215 through 217). Kentucky 9 coal from the Dotiki mine was fed to the pilot plant during Runs 213 and 214. Coal conversion ranged from 93.0% to 94.3% of the MAF coal, while the SRC yield ranged from 43% to 81% of the MAF coal. Recovery of SRC from the Critical Solvent Deashing (CSD) unit ranged from 72.7% to 91.3%. The objectives of the runs scheduled were: to evaluate the performance of deashing solvent B in the CSD unit in comparison with deashing solvent A; to investigate the processing of high-chlorine coal and to test the Industrial Filter and Pump Manufacturing Co. candle filter; to simulate the design conditions for a 6000 tpd SRC demonstration plant; and to evaluate the effects of increasing light SRC addition to the SRC unit with respect to overall unit performance, SRC yield, SRC sulfur content, and solvent balance.

28033 **(DOE/ET/10245—1(Vol.1)) Development of coatings for corrosion/erosion protection of internal components of coal gasification vessels: Volume I. Laser fused MCrAl coatings. Final report, 1 October 1977-1 April 1980.** Clark, P.R.; Packer, C.M.; Perkins, R.A. (Lockheed Palo Alto Research Labs., CA (USA)). 15 Mar 1981. Contract AC01-77ET10245. 154p. (FE—2592-29(Vol.1)). NTIS, PC A08/MF A01. Order Number DE81026860.

This report presents the results of a program of research to develop and evaluate sulfidation-resistant MCrALHf coatings for use on stainless and superalloy components in coal gasification process equipment. Alumina forming MCrAl coatings, where M is Co or Fe were found to be the best materials, having excellent resistance to attack by both high and low Btu gasification atmospheres with 1% H_2S at 1800°F (1255°K). The optimum composition was found to be 18 to 25% Cr, 8 to 10% Al, bal. Co or Fe. The addition of 1% Hf promoted oxide spall resistance. These coatings can be applied by slurry or thermal spray process; however, they must be dense and have a uniform crack and pore-free structure. It has been demonstrated that this can be accomplished by surface fusion with pulsed YAG or continuous CO_2 lasers. The conditions required for laser surface fusion have been determined and are within the capabilities of many commercial laser devices. The process appears to be uniquely suited to coating both large and small components and is recommended for further scale-up and development. 29 figures, 22 tables.

28034 **(DOE/ET/10245—1(Vol.2)) Development of coatings for corrosion/erosion protection of internal components of coal gasification vessels. Volume II. Furnace fused MCrAl coatings.** Perkins, R.A.; Clark, P.R.; Packer, C.M. (Lockheed Palo Alto Research Labs., CA (USA)). 15 Mar 1981. Contract AC01-77ET10245. 131p. (FE—2592-29(Vol.2)). NTIS, PC A07/MF A01. Order Number DE81026858.

This report presents the results of a program of research to develop and evaluate sulfidation-resistant MCrAl coatings for use on stainless steel and superalloy components of coal gasification process equipment. It is concerned with the development and evaluation of MCrAl coatings (where M is Fe, Ni, Co) which are produced by melting and alloying coating powders on the surface of high temperature alloy substrates in a vacuum furnace. It was found that 33Co-67Al and 33Cr-63A1-4Hf prealloyed powder mixtures fused into the surface of alloy 800 produced coatings that survived 2000 h at 1800°F (1255°K) in a low Btu coal gasification atmosphere with 1% H_2S. The addition of refractory sulfide formers such as Ti, Cb, and Mo in the CrAlHf composition reduced resistance to oxidation and shortened coating life. The best coating is 33Cr-63Al-4Hf on alloy 800. Detailed procedures for application of the coating are given and the effect of the coating and subsequent long time exposure to high sulfur low Btu coal gasification atmospheres on mechanical properties of the substrate are discussed. Factors that control performance and overall coating life are reviewed and recommendations for further development and evaluation of the coating are presented. 35 figures, 24 tables.

28035 **(DOE/ET/10517—T1) Part I. Coal hydrogenation via bonding of metallic compounds to coal; Part II. Solubilization of Illinois bituminous coal - the critical importance of methylene group cleavage. Final report.** (Cincinnati Univ., OH (USA). Dept. of Chemistry). 1981. Contract AS01-76ET10517. 23p. NTIS, PC A02/MF A01. Order Number DE81027562.

Progress reports are presented for the following two areas of study: Coal Hydrogenation via Bonding of Metallic Compounds to Coal; and Solubilization of Illinois Bituminous Coal - the Critical Importance of Methylene Group Cleavage. In the first report, data for the hydrogenation of Elkhorn coal at 390°C with the initial pressure of 13.8 MPa hydrogen and with various catalysts (stannous chloride and complexes of cobalt and tin), and solvents (decalin and tetralin) are presented in tabular form and results are discussed. To obtain more accurate information concerning the role of the catalyst and the mechanism of hydrogenation, model compounds of coal, polystyrene beads were tin-bonded and tin-impregnated, then hydrogenated under various temperatures, pressures, and with either decalin or tetralin. These data are also tabulated and discussed. Results show both hydrogen and the tin catalyst are necessary for liquefaction at 390°C, and under comparable conditions, bonded tin gave greater liquefaction than impregnated tin but with considerably greater hydrogen consumption. In the coal solubilization study, solubilization by hydroliquefaction and by chemical reduction with potassium in tetrahydrofuran seems to indicate that initial degradation of coal by both techniques proceeds by ether cleavage and that further degradation is achieved in both cases by methylene bridge attack. The NMR studies on hydroliquefaction products indicate that Illinois bituminous coal is structurally quite homogeneous since the product composition is largely independent of the degree of solubilization.

28036 **(DOE/ET/12103—T2) Development of new catalysts for coal liquids refining. Fourth quarterly report, October 1-December 31, 1979.** (Filtrol Corp., Los Angeles, CA (USA)). Jan 1980. Contract AC22-78ET12103. 37p. (FE—2595-4). NTIS, PC A03/MF A01.

Base-line catalyst testing conditions for hydrotreating SRC-II fuel Oil Blend have been determined: temperature, 750°F; pressure, 1000 psig; LHSV, 1 ml/ml-hr; and H_2 flow rate, 5000 SCF/bbl. At these conditions the average values for HDN and HDS after 24 hours on stream are $\approx$ 85% and 90% respectively with the best series of Ni-Mo on γ-alumina. Nickel and cobalt tungstate are significantly poorer catalysts. They afford 60-40% HDN and 85-75% HDS respectively. Nickel molybdate catalysts show higher activity for HDN than the analogous cobalt molybdate catalysts, however, the activity of both types of catalysts is not significantly different for HDS. Synthesis and characterization of various catalytic components and cation exchange of these materials is essentially complete. Exploratory cracking, hydrocracking, and hydrotreating catalysts are being produced in preparation for activity testing.

28037 **(DOE/ET/13060—T3(Vol.8)) Demonstration plant engineering and design. Phase I. The pipeline gas demonstration plant. Volume 8. Plant Section 600: CO_2 removal.** (Conoco, Inc., Stamford, CT (USA); Foster Wheeler Energy Corp., Livingston, NJ (USA)). 1981. Contract AC01-77ET13060. 34p. (FE—2542-38(Vol.8)). NTIS, PC A03/MF A01. Order Number DE81025503.

Contract No. EF-77-C-01-2542 between Conoco Inc. and the US Department of Energy provides for the design, construction, and operation of a demonstration plant capable of processing bituminous caking coals into clean pipeline quality gas. The project is currently in the design phase (Phase I). This phase is scheduled to be completed in June 1981. One of the major efforts of Phase I is the completion of the process design and the project engineering design of the Demonstration Plant. This design effort has been completed. A report of the design effort is being issued in 24 volumes. This is Volume 8 which reports the design of Plant Section 600 - CO_2 removal. The CO_2 Removal unit removes carbon dioxide

from the gas exiting the shift/methanation primary reactors (Plant Section 500). The removal of the carbon dioxide increases the gross heating value of the methanated gas from 404 to 880 Btu per standard cubic foot. The CO_2 free gas feeds the final methanator in Plant Section 500 which further upgrades the heating content of the SNG to pipeline quality standards. The carbon dioxide is removed from the methanated gas via absorption into a circulating solution of hot potassium carbonate. A Benfield process is employed for CO_2 removal. A portion of the CO_2 product from Plant Section 600 is used to pressurize the lock hoppers of the gasifier in Plant Section 300; the balance is vented to the atmosphere (26 million SCFC).

28038 **(DOE/ET/13060—T3(Vol.9)) Demonstration plant engineering and design. Phase I. The pipeline gas demonstration plant. Volume 9. Plant Section 800: product gas compression and drying.** (Conoco, Inc., Stamford, CT (USA); Foster Wheeler Energy Corp., Livingston, NJ (USA)). 1981. Contract AC01-77ET13060. 227p. (FE—2542-38(Vol.9)). NTIS, PC A11/MF A01.

Contract No. EF-77-C-01-2542 between Conoco Inc. and the US Department of Energy provides for the design, construction, and operation of a demonstration plant capable of processing bituminous caking coals into clean pipeline quality gas. The project is currently in the design phase scheduled to be completed in June 1981. One of the major efforts of Phase I is the completion of the process design and the project engineering design of the Demonstration Plant. This design effort has been completed. A report of the design effort is being issued in 24 volumes. This is Volume 9 which reports the design of Plant Section 800 - Product Gas Compression and Drying. Plant Section 800 compresses, cools, and drys the SNG product to conditions and specifications required for pipeline use. A conventional triethylene glycol (TEG) gas drying unit is employed to reduce the moisture content of the SNG to less than 7 pounds per million standard cubic feet. The product SNG has a minimum pressure of 800 psig and a maximum temperature of 100°F. This section also includes the product gas analysis, metering, and totalizing instruments. It is designed to remove 3144 pounds of water from 19 million SCFC of SNG product. Volume 9 contains the following design information: process operation; design basis; heat and material balance; stream compositions; utility, chemical and catalyst summary; major equipment and machinery list; major equipment and machinery requisitions; instrument list; instrument requisitions; line lists; process flow diagram; engineering flow diagrams; and section plot plan.

28039 **(DOE/ET/13060—T3(Vol.15)) Demonstration plant engineering and design. Phase I. The pipeline gas demonstration plant. Volume 15. Plant Section 2000: water treatment and steam plant.** (Conoco, Inc., Stamford, CT (USA); Foster Wheeler Energy Corp., Livingston, NJ (USA)). 1981. Contract AC01-77ET13060. 545p. (FE—2542-38(Vol.15)). NTIS, PC A23/MF A01. Order Number DE81025584.

Contract No. EF-77-C-01-2542 between Conoco Inc. and the US Department of Energy provides for the design, construction, and operation of a demonstration plant capable of processing bituminous caking coals into clean pipeline quality gas. The project is currently in the design phase (Phase I). This phase is scheduled to be completed in June 1981. One of the major efforts of Phase I is the process and project engineering design of the Demonstration Plant. The design has been completed and is being reported in 23 volumes. This is Volume 15 which covers the design of Plant Section 2000 - Water Treatment and Steam Plant. This unit provides fire water service water, boiler feed water and steam for the various users in the plant. The unit provides the necessary treatment for the various plant water systems. A clarification/softening step followed by filtration is included to produce service water for cooling tower make-up, chemical dilution, and other plant uses. An additional demineralization step is utilized to produce boiler feed water for the plant steam generators. The steam system consists of two gas-fired steam boilers which produce the steam requirement for plant start-up. When the plant is on stream, the waste heat steam generated is sufficient for most steam needs, and the boiler steam requirement is reduced to a minimum level. A turbogenerator is utilized to produce electricity and to provide a base steam load for the boilers when the plant is on stream.

28040 **(DOE/ET/13060—T3Vol.16) Phase I. Pipeline-gas demonstration plant. Demonstration plant engineering and design. Volume 16. Plant Section 2400 - cooling water.** (Conoco, Inc., Stamford, CT (USA); Foster Wheeler Energy Corp., Livingston, NJ (USA)). 1981. Contract AC01-77ET13060. 161p. (FE—2542-38Vol.16). NTIS, PC A08/MF A01. Order Number DE81027575.

Contract No. EF-77-C-01-2542 between Conoco Inc. and the US Department of Energy provides for the design, construction, and operation of a demonstration plant capable of processing bituminous caking coals into clean pipeline quality gas. The project is currently in the design phase (Phase I). This phase is scheduled to be completed in June 1981. One of the major efforts of Phase I is the process and project engineering design of the Demonstration Plant. The design has been completed and is being reported in 24 volumes. This is Volume 16 which reports the design of Plant Section 2400 - Cooling Water. The purpose of the Cooling Water section is to provide cooling water to process and utility units throughout the plant. An open recirculating cooling water system containing a forced-draft cooling tower is used. Plant Section 2400 contains a Cooling Water Chemical Feed System which provides for automatic and continuous monitoring of the circulating water quality. Corrosion and scaling are minimized by controlling the chemical dosages and by regulating the cooling tower blowdown. The cooling water system is designed to provide 85°F cooling water at a circulation rate of 18,000 gallons per minute. The design return temperature is based upon a maximum 30°F temperature rise in the various cooling exchangers.

28041 **(DOE/ET/13108—T14) Underground gasification of steeply dipping beds. Phase II report: results of Rawlins Test No. I. Final report, March 1, 1978-March 1, 1980.** (Gulf Research and Development Co., Pittsburgh, PA (USA); TRW Energy Systems Planning Div., McLean, VA (USA)). Jul 1981. Contract AC03-77ET13108. 271p. NTIS, PC A12/MF A01. Order Number DE81028581.

The first US field test of in situ gasification for a steeply dipping coal seam was completed in December 1979. Rawlins No. 1 was a success. Essentially all the objectives were met and much was learned about conducting the more complex Rawlins No. 2 field test. A 23 ft thick coal bed dipping at 63° was used to test the feasibility of using underground coal gasification techniques to extract energy from steeply dipping coal beds (UCG-SDB). The coal was ignited at a vertical depth of 400 ft utilizing a directionally drilled process well pair. Approximately 1200 tons of coal were utilized during the test. The heating value of the product gas during the 21 day air injection phase initially climbed to approximately 180 Btu/SCF and gradually declined to the 120 to 130 Btu/SCF range. Air injection rates of 1600 to 2000 SCFM were used, and wet product gas rates between 3000 and 4500 SCFM were obtained. A 5 day steam/oxygen injection test was also conducted which increased the product gas heating value to the 220 to 260 Btu/SCF range. Oxygen flows were generally kept between 300 to 1000 SCFM, producing between 1500 to 4000 SCFM. Steam/oxygen rations were varied between 0.2 and 2.7. The environmental studies concentrated on four major aspects; groundwater quality, air quality, surface subsidence and personnel industrial hygiene. Groundwater effects consisted of excursions in total organic carbon and ionic salts concentration. Air quality levels during the test showed little variation with levels collected during the same quarter of the baseline period. None of the standards for gaseous pollutants were violated due to flare emissions. Surface subsidence did not occur. The personnel industrial hygiene survey conducted during the test was generally favorable but pinpointed two areas which require redesign to reduce exposure to UCG products.

28042 **(DOE/ET/13153—T5) Short-residence-time hydropyrolysis. Technical progress report, 1 October-31 December 1980 and 1 January-31 March 1981.** Saville, D.A.; Russel, W.B. (Princeton Univ., NJ (USA). Dept. of Chemical Engineering). 1981. Contract AC01-79ET13153. 16p. (PU—3135-5). NTIS, PC A02/MF A01. Order Number DE81024330.

A fundamental study of the hydropyrolysis of small coal particles at high pressures and short residence times of both solid and gas is underway to elucidate the chemical and physical rate proc-

esses governing the yield. While previous experiments have roughly delineated conditions favorable toward high yields of gas and light aromatic liquids, a more basic understanding is needed for rational evaluation of designs involving different reactor geometries, coals and processing conditions for the production of a variety of liquid products. Our aim is to develop an understanding of short-contact-time hydropyrolysis based on studies which carefully isolate events occurring within single particles from effects due to gas phase reactions or slow quenching of the solid. A novel laboratory reactor has been fabricated which provides short residence times with rapid heating. Detailed chemical and physical analyses of both the parent coal and the product distribution are obtained as a function of extent of reaction and the process conditions. This data will then be analyzed in terms of a model for the coupling between the heat and mass transfer and chemical reactions within an individual particle Roughly 225 runs were made with PSOC 102, Pittsburgh Seam HVA bituminous. We now have results at several different pressures (0.1 Torr-1500 psi), temperatures (to 900°C), heating rates (to 10^4 °c/s) and particle sizes (50 μm, 85μm, 125μm)). All data were taken in helium and cover isothermal reaction times from 0 to 30s; a zero length reaction time is defined as heating to the prescribed temperature followed by an immediate quench.

28043 **(DOE/ET/14700—6) Chemistry and catalysis of coal liquefaction catalytic and thermal upgrading of coal liquid and hydrogenation of CO to produce fuels. Quarterly progress report, January-March 1981.** Wiser, W.H. (Utah Univ., Salt Lake City (USA). Dept. of Mining and Fuels Engineering). Jun 1981. Contract AC22-79ET14700. 56p. NTIS, PC A04/MF A01.

28044 **(DOE/FE/20219—1) Executive summary: feasibility and economic study of medium-Btu coal gas blended with high-Btu by-product gas as an industrial energy source at Billings, Montana.** (Northern Resources, Inc., Billings, MT (USA)). May 1981. Contract FG01-79RA20219. 23p. NTIS, PC A02/MF A01. Order Number DE81025166.

This study assesses the technical and economic feasibility of blending a medium-Btu gas (BMG) produced from coal by the Winkler fluidized bed gasification process with excess refinery fuel gas to be used as an industrial fuel in Billings, Montana. This report includes a discussion of the background of the project; the site selection process; the conceptual design of the process and supporting facilities; the retrofit requirements and other costs associated with burning the MBG; the environmental and permitting aspects of the project; the cost estimates and economic considerations; the contract provisions for MBG buy/sell agreements; the government's role in supporting the project; and the market potential for the project in Billings and similar projects in other markets. The study concludes that the project is technically feasible and economically viable today although parity with conventional fuels will not occur until 1985.

28045 **(DOE/FE/20222—1) Low/medium Btu coal gasification assessment of central plant for the City of Philadelphia, Pennsylvania. Executive summary.** (Philadelphia Gas Works, PA (USA)). Feb 1981. Contract FG01-79RA20222. 14p. NTIS, PC A02/MF A01. Order Number DE81027830.

From the 15 sites considered, the Philadelphia Gas Works and Riverside sites were considered excellent candidates. Early in the study it was decided that the level of risk associated with the gasification process should be minimal. It was therefore determined that the process should be selected from those commercially proven. The following processes were considered: Lurgi, Koppers-Totzek, Winkler, and Wellman-Galusha. From past experience and knowledge of the characteristics of each gasifier, a list of advantages and disadvantages of each process was formulated. The Galusha process offered the least capital and operating costs for low Btu gas (approximately 150 Btu per cu ft), and the KT and Lurgi emerged as the better processes for medium Btu gas (approximately 300 Btu per cu ft). A study was carried out to assess the impact on users having to switch from oil or natural gas to low or medium Btu gas. Medium Btu gas was selected in order to service many users with gas having generally useful combustion characteristics. For the production of 20 billion Btu per day two gasifiers are required, each gasifying about 500 tons of coal per day. Between the Lurgi and KT processes (which are competitive in terms of capital costs), the KT process shows a lower operating cost and is more flexible in terms of coal feed selection. In addition, the Lurgi (and the Galusha) gasifiers produce tars, phenols, and ammonia. Effective removal of these by-products adds to the complexity and operating inconvenience of the overall process. Therefore, the KT process (which is unique in its ability to gasify many coals) was selected. It is probable that most users would perfer to install dual fuel burners and retain some fuel oil storage capability.

28046 **(DOE/FE/50135—1) Conceptual design for a multi-user medium Btu Coal Gasification Complex.** (AmeriGas, Inc., Valley Forge, PA (USA)). Sep 1980. Contract FG01-80RA50135. 18p. NTIS, PC A02/MF A01. Order Number DE81027681.

A study conducted for AmeriGas by Reed Process Company in July 1979 sought to determine the most economical process and gas heating value which could be offered to local industrial plant customers. The conclusion of the Reed study encouraged AmeriGas and other parties involved to respond to program information notice NPI RA-21 for a grant for further conceptual studies. After further studies, based on the design of a gasification plant to provide 8.3 billion Btu per day in the form of intermediate Btu gas of 250 Btu/SCF, the basic conclusion, based upon the $6.45/MM Btu required selling price for IFG for this project, was that the facility, as designed, does not present a viable business opportunity for AmeriGas. It is not that coal gasification is uneconomical but merely the combination of this particular coal gasification system design and the assumptions used in its evaluation. Still existing are the customers' need for long term, stable supplies of clean energy with high fuel utilization load factors. The failure of this study to produce a viable business opportunity does not condemn the process or the project. It was concluded that even at $6.45/MM Btu the economic attractiveness of the project was not as poor as originally perceived. When the recent volatile energy price variations are coupled with current rates of inflation and proposed deregulation of natural gas, the long-term attractiveness of IFG is visible. The hurdle here is convincing management that the risks of accepting a higher, yet secure cost of energy now is more than off-set by future savings. This requires a very forward looking attitude and a confidence that history predicts the future.

28047 **(DOE/FE/50135—2) Conceptual design for a multi-user medium Btu coal gasification complex.** (AmeriGas, Inc., Valley Forge, PA (USA)). Sep 1980. Contract FG01-80RA50135. 106p. NTIS, PC A06/MF A01. Order Number DE81027139.

A study conducted for AmeriGas by Reed Process Company in July, 1979 sought to determine the most economical process and gas heating value which could be offered to two local industrial plant customers. The conclusion of the Reed study encouraged AmeriGas and other parties involved to respond to program information notice NPI RA-21 for a grant for further conceptual studies. On the basis of fuel requirements, a gasifier to produce immediate Btu gas (250 Btu/SCF) at a sale of 8.3 million Btu/day was designed. The basic conclusion, based upon the $6.45/MM Btu required selling price for IFG for this project, was that the facility, as designed, does not present a viable business opportunity for AmeriGas. Still existing are the customers' need for long term, stable supplies of clean energy with high fuel utilization load factors. The failure of this study to produce a viable business opportunity does not condemn the process or the project. Finally, it was concluded that even at $6.45/MM Btu the economic attractiveness of the project was not as poor as originally perceived. When the recent volatile energy price variations are coupled with current rates of inflation and proposed deregulation of natural gas, the long-term attractiveness of IFG is visible. The hurdle here is convincing management that the risks of accepting a higher, yet secure cost of energy now is more than off-set by future savings. Various financial incentives are considered. (LTN)

28048 **(DOE/MC—148) Summary test report W-K-M Pow-R-Seal Gate Valve METC SOA Test Valve No. A-22 state-of-the-art lockhopper valve-testing and development project.** Gardner, J.F.; Galvin, W.E.; Griffith, R.A.; Hall, R.C.; Horneck, R.G.; Maxfield, D.A.; Nutter, T.M.; Sgamma, R.B. (TRW Energy Engineering Div., Morgantown, WV (USA)). Apr 1981. Contract AM21-80MC14522. 28p. NTIS, PC A03/MF A01. Order Number DE81025185.

The W-K-M Pow-R-Seal Gate Valve (METC SOA Test Valve No. A-22) completed static testing. During static testing the actuator motor overheated, suggesting that continuous-duty actuator motors will be required for lockhopper applications. The external leakage rates reached over 0.4 scfm despite repeated tightening of the packing gland. Internal leakage started increasing significantly at the end of the 300°F test series. During the final ambient-temperature test series, internal-leakage rates of 0.8 to 13.0 scfm were measured. Both the internal and external leakage exceeded the allowable limits for static testing (6.0 and 0.1 scfm, respectively). When the valve was removed from the test unit, gross damage to the seats and gate was visible. The through-conduit design of this valve should have considerable potential for high-temperature solids service. It is recommended that the specific configuration and materials used in this valve be reviewed and a modified valve submitted for further testing.

28049 **(DOE/MC/12050—149) Assessment of fuel-gas-cleanup systems. Final report.** Robson, F.L.; Blecher, W.A. (United Technologies Research Center, East Hartford, CT (USA)). Nov 1980. Contract AC21-79MC12050. 200p. NTIS, PC A09/MF A01. Order Number DE81025927.

This report presents the results of a study to evaluate the performance, economics and emission characteristics of low-, medium-, and high-temperature fuel gas cleanup processes for use in coal gasification combined-cycle power plants based on high-temperature gas turbines. Processes considered were the Allied Chemical low-temperature Selexol process, METC medium-temperature iron oxide process and Conoco high-temperature half-calcined dolomite process. Process evaluations were carried out for twenty-four combinations of gasifiers and cleanup processes. Based upon the process evaluations, five combinations of gasifiers and cleanup process were selected for integration with an advanced, 2600 F gas turbine into an overall power system. Heat and mass balances and process schematics for these plants were prepared and the cost of electricity estimated. The results of the study indicate that medium- or high-temperature cleanup systems in combined-cycle power plants could meet or exceed EPA New Source Performance Standards. Performance and cost of the systems studied can be improved by high- and intermediate-temperature cleanup systems or by integration of developmental hot gas heat exchangers with suitable commercially available low-temperature cleanup systems. Unresolved problems in the use of medium- and high-temperature cleanup are efficient regeneration of iron oxide, particulate removal at high temperature and the fate of fuel bound nitrogen and trace metals that may appear in the hot fuel gas.

28050 **(DOE/MC/14739—T6) Transfer of ASPEN technology to METC. Project status report, April 1-May 31, 1981.** (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). 1 Jun 1981. Contract AC21-80MC14739. 105p. NTIS, PC A06/MF A01. Order Number DE81026361.

A non-kinetic ASPEN mathematical model of the Conoco-designed Lurgi slagging gasifier is presented. Validation of the model, process heat and material balance, etc. of sections of the process are presented. Equipment sizing and costing data are being prepared. (LTN)

28051 **(DOE/PC/30088—5) Coal-transformation chemistry. Fifth quarterly progress report.** Stock, L.M. (Chicago Univ., IL (USA)). 1981. Contract AC22-80PC30088. 27p. NTIS, PC A03/MF A01. Order Number DE81025977.

Colorado subbituminous coal was reduced with potassium in the presence of naphthalene in tetrahydrofuran. The reaction proceeded more effectively with higher concentrations of naphthalene. The coal polyanion was alkylated with methyl iodide and butyl iodide. The coal products were separated from the electron transfer agent by chromatography and the spectroscopic properties of the tetrahydrofuran-soluble alkylated properties were examined. Quantitative analyses of the carbon nmr spectra revealed that the alkylated Colorado subbituminous coal is much richer in O-alkylation products than the alkylated Illinois No. 6 bituminous coal and that there are significant quantities of carboxylic acids in the Colorado coal. Illinois No. 6 coal was methylated reductively in liquid ammonia and its tetrahydrofuran solubility and spectra properties were studied. The same coal sample was then subjected to a second selective methylation and its solubility and spectroscopic properties were examined. O-Alkylation did not proceed to completion during the first alkylation reaction. However, selective methylation using tetrabutylammonium hydroxide as a catalyst yielded virtually complete O-alkylation. An isotopically enriched, reductively methylated Illinois bituminous No. 6 coal was treated with mild acid in an effort to determine the quantity of vinyl ethers present in the alkylated products. It was concluded that methyl vinly ethers are not present among the alkylation products of Illinois No. 6 coal. The influence of inorganic sulfur compounds on the deuterim-hydrogen reactions of diphenylmethane and tetralin-d_{12} were studied.

28052 **(DOE/PC/30141—T4) Laboratory study for removal of organic sulfur from coal. Final report.** (TRW, Inc., Redondo Beach, CA (USA)). 1 Jul 1981. Contract AC22-80PC30141. 210p. NTIS, PC A10/MF A01. Order Number DE81025132.

Following the introduction which contains a description of the Gravimelt Process and Project Statement of Work, a description of laboratory experimental equipment and a detailed discussion of the results is presented. Initial and concluding engineering design and cost estimations are presented in the following section. The last two sections contain recommendations for future work and an appendix of laboratory data. The TRW Gravimelt Process involves the treatment of mine-cleaned coal with molten potassium and or sodium hydroxide to chemically extract both organic and pyritic sulfur into the molten alkali. The coal mineral content is broken down to forms insoluble in water but soluble in a second liquid, usually dilute sulfuric acid. The high density of the melt causes the desulfurized coal to float to the surface, where it is skimmed off. The coal is then washed with water to completely recover the alkali metal and the coal is dried. If the coal is next washed with a second liquid, almost all of the mineral matter is extracted into the solution.

28053 **(DOE/PC/30243—T1) Experimental study of the multiple steady states in an adiabatic coal-liquefaction reactor. Progress report, September 1, 1980-February 28, 1981.** Shah, Y.T. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). 1981. Contract FG22-80PC30243. 14p. NTIS, PC A02/MF A01. Order Number DE81027112.

The purpose of the proposed study is to investigate experimentally the thermal behavior of coal liquefaction reactors. Specifically, the occurrence of multiple steady states in a continuous-stirred-tank, adiabatic, three-phase reactor will be investigated over a wide range of operating conditions. A special adiabatic coal liquefaction reactor has been designed and is being built. Blueprints for the detailed design of the reactor are attached. In this custom-made reactor the standard 1 liter autoclave is insulated in three parts. The insulation encompasses the controllers and heating elements such that the heat losses through the walls and the stirrer shaft are negligible. As noted on the attached blueprint, both reactor and the stirrer shaft are well insulated. It is estimated that this custom-made vessel will give the ratio of heat loss through reactor walls/heat generated to less than 0.05.

28054 **(DOE/RA/20223—T1) Low/medium-Btu coal-gasification assessment program for specific sites of two New York utilities.** (New York State Energy Research and Development Authority, Albany (USA)). Dec 1980. Contract FG01-79RA20223. 377p. NTIS, PC A17/MF A01. Order Number DE81025518.

The scope of this study is to investigate the technical and economic aspects of coal gasification to supply low- or medium-Btu gas to the two power plant boilers selected for study. This includes the following major studies (and others described in the text): in-

vestigate coals from different regions of the country, select a coal based on its availability, mode of transportation and delivered cost to each power plant site; investigate the effects of burning low- and medium-Btu gas in the selected power plant boilers based on efficiency, rating and cost of modifications and make recommendations for each; and review the technical feasibility of converting the power plant boilers to coal-derived gas. The following two coal gasification processes have been used as the basis for this Study: the Combustion Engineering coal gasification process produces a low-Btu gas at approximately 100 Btu/scf at near atmospheric pressure; and the Texaco coal gasification process produces a medium-Btu gas at 292 Btu/scf at 800 psig. The engineering design and economics of both plants are described. Both plants meet the federal, state, and local environmental requirements for air quality, wastewater, liquid disposal, and ground level disposal of byproduct solids. All of the synthetic gas alternatives result in bus bar cost savings on a yearly basis within a few years of start-up because the cost of gas is assumed to escalate at a lower rate than that of fuel oil, approximately 4 to 5%.

28055 **(EPRI-AP—1942) Preliminary oxygen-plant assessment for Texaco gasifier-based gasification - combined-cycle systems. Final report.** Drnevich, R.F. (Union Carbide Corp., Tonawanda, NY (USA). Linde Div.). Jul 1981. 68p. NTIS, PC A04/MF A01. Order Number DE81903807.

EPRI Report AP-1674 was published to provide users of GCC systems with a basic understanding of commercial oxygen production technology. This report supplements AP-1674 by characterizing an oxygen supply system configuration for use with a Texaco-gasifier-based GCC system. The selected design is based on existing oxygen plant design and operating data, and the report focuses on the considerations that must be addressed to provide the load-following and turndown capabilities required for use with GCC systems.

28056 **(FE-MIT—2295T27-7) Coal pyrolysis by hot solids in a fluidized-bed combustor. Progress report, June 1, 1979-February 29, 1980.** Longwell, J.P.; Howard, J.B.; Peters, W.A.; Floess, J.K. (Massachusetts Inst. of Tech., Cambridge (USA)). Mar 1980. Contract EX-76-C-01-2295-027. 15p. NTIS, PC A02/MF A01.

The results from three pyrolysis runs with Texas lignite and sand are presented as yields of gaseous compounds, tar, and char per unit weight of dry and dry, ash-free coal. The composition of the pyrolysis gases, on a H_2O and N_2-free basis, as a function of time, are presented in figures. The data shows that the gas composition rapidly reaches a steady state composition at the start of each run, but alters considerably after feeding of the coal has stopped. The change in composition appears to be dominated by an increase in the H_2 mole fraction. The changes in composition that occurred during the steady state part of the run were largely due to temperature variations in the fluidized bed and freeboard zones of the reactor during the runs. In these initial tests we had some difficulty maintaining isothermal conditions in the reactor.

28057 **(LBL—12807) Novel design of pressure vessels and thermal shields in coal gasifiers.** Loo, B.W. (Lawrence Berkeley Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 11p. (CONF-810607—11). NTIS, PC A02/MF A01. Order Number DE81025828.

From Symposium on instrumentation and control for fossil energy processes; San Francisco, CA, USA (8 Jun 1981).

This report describes a proposed solution to two outstanding problems in commercial-sized coal gasifiers, namely, detecting and locating any deterioration in the refractory thermal barrier and the construction of a safe pressure vessel utilizing advanced carbon fiber composite technology. Design considerations are given for a typical gasifier some 30 feet in diameter by 150 feet tall with a maximum internal temperature and pressure of 2500°F and 1500 psi respectively. A system of computer controlled cooling circuits is deployed between the refractory barrier and the external lightweight pressure vessel. Multiple levels of redundancy are built in to guard against any component failure. Through the sensing of coolant temperature and the modulation of coolant flow, a map of heat flux distribution over the gasifier wall may be generated with a spatial resolution of about 5 feet. It seems possible to maintain the coolant temperature rise by no more than 90°F with only a modest amount of coolant flow.

28058 **(MIT—2295T9-17) Computer-aided industrial-process design, the ASPEN project. Seventeenth and eighteenth quarterly progress report, June 1-November 30, 1980.** (Massachusetts Inst. of Tech., Cambridge (USA)). 15 Dec 1980. Contract AT01-76ET10696. 134p. NTIS, PC A07/MF A01. Order Number DE81023156.

The maintenance, testing and debugging of the ASPEN system has been an ongoing major activity. Maintenance work was generated from internal testing, use of the production version of ASPEN by industrial participants and a known backlog of problem areas. The implementation of the enhancements discussed under Task 12 led to additional maintenance work. The computing environment for ASPEN usage and maintenance has been previously established and described. The key components are the in-house development version of ASPEN, the production version of ASPEN for use by industrial participants and the CMS procedures for running ASPEN, debugging and making program changes. Many changes were made to programs and procedures, numbering in the thousands. Most of these were minor changes reflecting the natural evolution of a system of this size. The more significant of these are described. During the coming quarters, a training course will be conducted about once each month, alternating between Introductory and Advanced Courses. The major rewrite of the ASPEN User's Manual will be continued. As in the past, the aim will be to enhance its comprehensibility and incorporate any additional ASPEN features which have been developed. The detailed work accomplished in the last two quarters is reported in two sections: the User's Manual and Training Courses.

28059 **(MLM-MU—81-62-0005) Post-burn core analysis of samples from the Pricetown I U.C.G. field test, Pricetown, West Virginia: Phase I.** Zielinski, R.E.; Webb, J.C. (Mound Facility, Miamisburg, OH (USA)). 1981. Contract AC04-76DP00053. 71p. NTIS, PC A04/MF A01. Order Number DE81024214.

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Visual description, mineralogic, and geochemical analyses of post-burn cores from the Pricetown, West Virginia, U.C.G. Field Test have produced several conclusions. Alteration effects due to the burn, in order of increasing temperature, consisted of patchy to pervasive staining and saturation of shale and coal by tar (produced during the coal burn). Dehydration and subsequent formation of microfractures has occurred in associated shales. Oxidation of pyrite has occurred. Intense baking, resulted in darkening of coal and an increase in hardness of the shale. Destruction of kaolinite, chlorite, and illite has occurred. The percent of quartz in the shale has increased. Crystallization of high-temperature mineral phases, such as mullite ($Al_6Si_2O_3$), cristobalite (SiO_2), which are typical of ceramic materials, has occurred. Crystallization of pyrrhotite and magnetite from a melt, which was derived from pyrite has occurred. Melting and cooling of adjacent shale, produced highly vesicular, pumice-like rock. Melting and cooling of shale produced medium-crystalline rock, lacking vesicular structure. Coking and burning of coal, resulted in vesicular coal fragments and ash. Core C-3, located more in the heart of the test zone, showed extensive evidence of physical and mineralogical alterations that were the result of the coal burn. These included staining and saturation by coal tar in the shale overlying the coal; oxidation of pyrite; microfracturing; baking of shale, including discoloration and development of vesicular structure; melting of shale, resulting in highly vesicular rock; melting and slow cooling of the shale, resulting in medium-crystalline rock; destruction of pyrite and precipitation of pyrrhotite and magnetite from an iron-sulfide melt; destruction of clay minerals; and a rubble-filled cavity.

28060 **(SAND—81-0138C) Slurry-phase catalysis of direct coal liquefaction by iron sulfides.** Stephens, H.P.; Stohl, F.V.; Padrick, T.D. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 6p. (CONF-810914—2). NTIS, PC A02/MF A01. Order Number DE81024325.

From International conference on coal science; Dusseldorf, F.R. Germany (7 Sep 1981).

Although these studies of the kinetics of pyrite decomposition, sulfide surface area changes, and the effect of sulfide additions on product distributions convincingly imply that pyrrhotites, in equilibrium with H_2S, are the significantly active catalytic species of the iron sulfide system, the mechanism of their catalysis of coal liquefaction remains unknown. Surface science experiments are currently being pursued to identify the catalytically active sites for pyrrhotites.

28061 **(UCRL—85173) Burn cavity growth during the Hoe Creek No. 3 underground coal gasification experiment.** Hill, R.W. (Lawrence Livermore National Lab., CA (USA)). 14 Jan 1981. Contract W-7405-ENG-48. 22p. (CONF-810909—1). NTIS, PC A02/MF A01.

From Institute of Gas Research conference; Los Angeles, CA, USA (28 Sep 1981).

A detailed history is given of the growth of the burn cavity during the first month of the Hoe Creek No. 3 underground coal gasification experiment near Gillette, Wyoming, in 1979. The changing shape of the cavity with time is inferred from data from three types of instruments installed throughout the experimental zone: (1) thermocouples at various levels in a number of holes, to map temperatures; (2) extensometers at various levels in other holes, to detect motions of the overburden material; and (3) high-frequency electromagnetic (HFEM) scans made between various pairs of holes, to detect cavities and zones of burning coal. Additional data on the final shape of the underground cavity are derived from the results of a core drilling program carried out from the surface after the burn had ended. This study of cavity growth history has contributed significantly to our understanding of how the in situ coal gasification process operates in sites like Hoe Creek. The diagnostic system provided invaluable information on cavity growth and on the interaction between the two coal seams. Some new problems with injection well survival and slag production in oxygen-steam burns were brought out, and the importance of understanding and controlling heat loss mechanisms was amply demonstrated. Although no one system of underground diagnostics can give all of the information needed to fully describe the in situ process, a combination of several diagnostic systems can be used to deduce a self-consistent description.

28062 **(UCRL—85173-R-1) Burn cavity growth during the Hoe Creek No. 3 underground-coal-gasification experiment.** Hill, R.W. (Lawrence Livermore National Lab., CA (USA)). 8 Jun 1981. Contract W-7405-ENG-48. 26p. (CONF-810923—4(R-1)). NTIS, PC A03/MF A01. Order Number DE81027533.

From 7. underground coal conversion symposium; Fallen Leaf Lake, CA, USA (8 Sep 1981).

A detailed history is given of the growth of the burn cavity during the first month of the Hoe Creek No. 3 underground coal gasification experiment near Gillette, Wyoming, in 1979. The changing shape of the cavity with time is inferred from data from three types of instruments installed throughout the experimental zone: (1) thermocouples at various levels in a number of holes, to map temperatures; (2) extensometers at various levels in other holes, to detect motions of the overburden material; and (3) high-frequency electromagnetic scans made between various pairs of holes, to detect cavities and zones of burning coal. Additional data on the final shape of the underground cavity is derived from the results of a core drilling program carried out from the surface after the burn had ended. This study of cavity growth history has contributed significantly to our understanding of how the in-situ coal gasification process operates in sites like Hoe Creek. The diagnostic system provided invaluable information on cavity growth and on the interaction between the two coal seams. Some new problems with injection well survival and slag production in oxygen-steam burns were brought out, and the importance of understanding and controlling heat loss mechanisms was amply demonstrated. Although no one system of underground diagnostics can give all of the information needed to fully describe the in-situ process, a combination of several diagnostic systems can be used to deduce a self-consistent description.

28063 **(UCRL—85852) Controlled retracting injection point (CRIP) system: a modified-stream method for in situ coal gasification.** Hill, R.W.; Shannon, M.J. (Lawrence Livermore National Lab., CA (USA)). 15 Apr 1981. Contract W-7405-ENG-48. 10p. (CONF-810923—2). NTIS, PC A02/MF A01. Order Number DE81026477.

From 7. underground coal conversion symposium; Fallen Leaf Lake, CA, USA (8 Sep 1981).

The underground coal gasification process, in practice, is subject to various problems that make it difficult to maintain and control an efficient long-term operation. One of the major problems is the need to move the injection point (where the combustion-supporting air or oxygen from the surface is fed into the coal seam) to new areas of unburned coal as the burn progresses. To achieve better control of the gasification process, we recommend the controlled retracting injection point or CRIP system. The controlled retracting injection point or CRIP system is designed to keep the injection point on the bottom of the coal seam and to move it backwards away from the collapse zone into fresh, solid coal. The principle of controlled retraction allows the operator to choose the optimum time and distance to move the injection point, and consequently the burn zone, to get the best possible performance from the gasifier. Although this system will work with coal seams of any thickness, it is particularly well suited to thick coal seams where the cavity grows by coal collapse as well as combustion. Placement of the production channel at the top of the seam above the injection well ensures isolation from the effects of collapse and reduces the risk of plugging the production well.

28064 **(UCRL—86260) Solar coal-gasification reactor for hydrocarbon-free synthesis gas.** Aiman, W.R. (Lawrence Livermore National Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 10p. (CONF-810469—3). NTIS, PC A02/MF A01. Order Number DE81026600.

From Solar Thermal Test Facilities Users Association annual business and technical meeting; Pasadena, CA, USA (20 Apr 1981).

In many applications, the hydrocarbon content of the synthesis gas produced in coal gasification is very valuable. In SNG production, the end product is a high Btu gas composed of methane and higher hydrocarbons. Furthermore, the liquid hydrocarbons can be even more valuable as feedstocks for other processes. In other applications such as methanol production, the hydrocarbon content of the synthesis gas is a non-reactive diluent that must be bled away from the product synthesis area to keep its concentration from buildng up. The liquid hydrocarbons that are a valuable product in a large-scale plant can cost more to remove from the synthesis gas than they are worth in a small-scale plant. In addition to the above benefits, this reactor requires substantially less steam in the coal gasification process. The reactor is able to produce hydrocarbon-free synthesis gas because it withdraws the pyrolysis gases from the reactor as they are formed and reinjects them above the char gasification zone where they are steam reformed into CO, CO_2, and H_2. Since almost all of the hydrocarbons released in coal gasification come off with the pyrolysis gases, the reactor will produce nearly hydrocarbon-free gas.

28065 **(DOE/ET/13060—T3Vol.24Bk.2) Phase I: the pipeline-gas demonstration plant. Demonstration plant engineering and design.** (Conoco, Inc., Stamford, CT (USA); Foster Wheeler Energy Corp., Livingston, NJ (USA)). 1981. Contract AC01-77ET13060. 469p. (FE—2542-38Vol.24Bk.2). NTIS, PC A20/MF A01. Order Number DE81026952.

Contract No. EF-77-C-01-2542 between Conoco Inc. and the US Department of Energy provides for the design, construction, and operation of a demonstration plant capable of processing bituminous caking coals into clean pipeline quality gas. The project is currently in the design phase (Phase I). This phase is scheduled to be completed in June 1981. One of the major efforts of Phase I is the completion of the process design and the project engineering design of the Demonstration Plant. This design effort has been completed. A report of the design effort is being issued in 24 volumes. This is Volume 24 which reports the specifications for the engineering design, equipment fabrication, and erection of the Demonstration Plant. These are generically termed the Job Specifications. The Job Specifications are divided into ten parts: Basic Engineering Data, Towers and Pressure Vessels, Heat Transfer Equip-

ment, Mechanical Equipment, Civil Engineering, Piping, Instruments, Electrical, Materials Protection, Support Facilities and Miscellaneous. The Job Specifications were devised by Foster Wheeler Energy Corporation, Conoco Inc., and the US Army Engineering Division - Huntsville. They are specific for the Demonstration Plant.

28066 **(DOE/ET/13060—T3(Vol.24)(Bk.1)) Phase I: the pipeline-gas demonstration plant. Demonstration plant engineering and design.** (Conoco, Inc., Stamford, CT (USA); Foster Wheeler Energy Corp., Livingston, NJ (USA)). 1981. Contract AC01-77ET13060. 348p. (FE—2542-38(Vol.24)(Bk.1)). NTIS, PC A16/MF A01. Order Number DE81026206.

Contract No. EF-77-C-01-2542 between Conoco Inc. and the US Department of Energy provides for the design, construction, and operation of a demonstration plant capable of processing bituminous caking coals into clean pipeline quality gas. The project is currently in the design phase (Phase I). This phase is scheduled to be completed in June 1981. One of the major efforts of Phase I is the completion of the process design and the project engineering design of the Demonstration Plant. This design effort has been completed. A report of the design effort is being issued in 24 volumes. This is Volume 24 which reports the specifications for the engineering design, equipment fabrication, and erection of the Demonstration Plant. These are generically termed the Job Specifications. The Job Specifications are divided into ten parts: Basic Engineering Data, Towers and Pressure Vessels, Heat Transfer Equipment, Mechanical Equipment, Civil Engineering, Piping, Instruments, Electrical, Materials Protection, and Support Facilities and Miscellaneous. The Job Specifications were devised by Foster Wheeler Energy Corporation, Conoco Inc., and the US Army Engineering Division - Huntsville. They are specific for the Demonstration Plant.

28067 **(DOE/ET/13060—T3Vol.24Bk.4) Phase I. Pipeline-gas demonstration plant. Demonstration plant engineering and design. Volume 24, Book 4. Job specifications.** (Conoco, Inc., Stamford, CT (USA); Foster Wheeler Energy Corp., Livingston, NJ (USA)). 1981. Contract AC01-77ET13060. 312p. (FE—2542-38Vol.24Bk.4). NTIS, PC A14/MF A01. Order Number DE81027576.

Contract No. EF-77-C-01-2542 between Conoco Inc. and the US Department of Energy provides for the design, construction, and operation of a demonstration plant capable of processing bituminous caking coals into clean pipeline quality gas. The project is currently in the design phase (Phase I). This phase is scheduled to be completed in June 1981. One of the major efforts of Phase I is the completion of the process design and the project engineering design of the Demonstration Plant. This design effort has been completed. A report of the design effort is being issued in 24 volumes. This is Volume 24 which reports the specifications for the engineering design, equipment fabrication, and erection of the Demonstration Plant. These are generically termed the Job Specifications. The Job Specifications are divided into ten parts: basic engineering data, towers and pressure vessels, heat transfer equipment, mechanical equipment, civil engineering, piping, instruments, electrical, materials protection, and support facilities and miscellaneous. The Job Specifications were devised by Foster Wheeler Energy Corporation, Conoco Inc., and the US Army Engineering Division - Huntsville. They are specific for the Demonstration Plant.

28068 **(DOE/ET/13060—T3Vol.24Bk.3) Demonstration plant engineering and design. Phase I. Pipeline-gas demonstration plant. Volume 24, Book 3. Job specifications.** (Conoco, Inc., Stamford, CT (USA); Foster Wheeler Energy Corp., Livingston, NJ (USA)). 1981. Contract AC01-77ET13060. 372p. (FE—2542-38Vol.24Bk.3). NTIS, PC A16/MF A01. Order Number DE81026478.

Contract No. EF-77-C-01-2542 between Conoco inc. and the US Department of Energy provides for the design, construction, and operation of a demonstration plant capable of processing bituminous caking coals into clean pipeline quality gas. The project is currently in the design phase (Phase I). This phase is scheduled to be completed in June 1981. One of the major efforts of Phase I is the completion of the process design and the project engineering design of the Demonstration Plant. This design effort has been completed. A report of the design effort is being issued in 24 volumes. This is Volume 24 which reports the specifications for the engineering design, equipment fabrication, and erection of the Demonstration Plant. These are generically termed the Job Specifications. The Job Specifications are divided into ten parts: basic engineering data, towers and pressure vessels, heat transfer equipment, mechanical equipment, civil engineering, piping, instruments, electrical, materials protection, support facilities and miscellaneous. The Job Specifications were devised by Foster Wheeler Energy Corporation, Conoco Inc., and the US Army Engineering Division - Huntsville. They are specific for the Demonstration Plant.

28069 **Near-threshold fatigue crack growth in 2/one quarter/Cr-1Mo pressure vessel steel in air and hydrogen.** Ritchie, R.O.; Suresh, S. (MIT, Cambridge, Mass). *Journal of Engineering Materials and Technology ;* **102**: No. 3, 293-299(Jul 1980).

As part of an ongoing program to examine subcritical flaw growth in candidate steels for proposed coal gasifier pressure vessels, an initial study is made of characteristics of ultralow growth rate fatigue crack propagation in thick-section, normalized 2/one quarter/Cr-1Mo pressure steel (ASTM A387, Class 2 Grade 22). Crack propagation data are generated over a wide range of growth rates, from 10/sup -8/ to 10/sup -2/ mm/cycle, for load ratios between 0.05 and 0.80 at ambient temperatures in low pressure environments of moist air, dry hydrogen gas and dry argon gas. 26 refs.

28070 **(DOE/ET/13060—T6) Pipeline-Gas Demonstration Plant. Phase I. Procurement plan for water, power, fuels, catalysts and chemicals.** Leaman, G.J. Jr.; DiFulgentiz, R.A. (Conoco, Inc., Stamford, CT (USA)). [nd]. Contract AC01-77ET13060. 100p. (FE—2542-42). NTIS, PC A05/MF A01. Order Number DE81027577.

Contract No. EF-77-C-01-2542 between Conoco Inc. and the United States Department of Energy provides for the design, construction and operation of a Demonstration Plant capable of converting high sulfur, bituminous caking coal to clean pipeline quality gas. One of the assignments under the contract is to find potential suppliers of water, power, fuels, catalysts and chemicals for operation of the plant. Muskingum Watershed Conservancy District, a State of Ohio governmental division, has agreed to supply raw water for the plant from Senecaville Reservoir. Potable water will be purchased from the Clear Water Corporation. Power will be purchased from Washington Electric Cooperative. Natural gas for plant start-up will be obtained from Texas Eastern Transmission Corporation. Fuel oil, fluxing agents, catalysts, and chemicals will, for the most part, be purchased by competitive bid during Phase II of the project.

28071 **(DOE/ET/13060—T7) Pipeline-gas demonstration plant, Phase I. Long-lead-time items.** Ditter, D.J. Jr. (Conoco, Inc., Stamford, CT (USA)). [nd]. Contract AC01-77ET13060. 51p. (FE—2542-41). NTIS, PC A04/MF A01. Order Number DE81027863.

Contract No. EF-77-C-01-2542 between Conoco Inc. and the US Department of Energy provides for the design, construction and operation of a demonstration plant capable of processing bituminous caking coals into clean pipeline quality gas. The project is currently in the design phase (Phase I), scheduled to be completed in June 1981. Task X in Phase I requires the identification of long lead time items and submission of a schedule for their procurement. It has been determined that there are no items requiring procurement procedures prior to Phase II. Further, there are no items for which detailed engineering must be completed in Phase I to prevent a negative impact on the Phase II, Demonstration Plant Construction schedule. Placement of purchase orders at an early stage in Phase II is critical for some equipment because vendor drawings for these pieces of equipment are necessary before detailed design/drafting can be completed.

28072 **(DOE/ET/13060—T8) Pipeline-Gas Demonstration Plant, Phase I. Federal, state, and local permits.** Leaman, G.J. Jr. (Conoco, Inc., Stamford, CT (USA)). [nd]. Contract AC01-77ET13060. 97p. (FE—2542-43). NTIS, PC A05/MF A01. Order Number DE81027824.

Contract No. EF-77-C-01-2542 between Conoco Inc. and the United States Department of Energy provides for the design, construction and operation of a demonstration plant capable of converting high sulfur bituminous caking coal to clean pipeline quality gas. One assignment under the contract is to obtain all necessary permits and licenses from federal, state and local governing bodies and agencies for construction and operation of the Demonstration Plant. All permits required before construction can begin have been obtained. Other permits will be obtained at the start of construction of the Demonstration Plant. Operating permits will be obtained after completion of various sections of the plant and before start-up of the entire plant. At this time, no permit has been denied by a regulatory authority.

0106 Properties

REFER ALSO TO CITATION(S) 28035, 28038, 28041, 28051, 28129, 28133, 28142, 28148, 28616, 29048

28073 (CONF-810498—(Vol.2), pp 640-650) **Stability and rheology of coal-oil mixtures and coal-water mixtures.** Marlow, B.J.; Rowell, R.L. (Univ. of Massachusetts, Amherst). 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

The main points of several earlier investigations of coal-oil mixtures determined by sedimentation, subsidence, consistency and viscosity are briefly reviewed. The structure and stability of coal-oil mixtures (COM) and coal-water mixtures (CWM) have much in common so that similar techniques may be used. A desirable COM or CWM dispersion is a loosely flocculated homogeneous network that yields readily to flow. The sedimentation column method developed for COM is applied to CWM to monitor the time-dependence of the absolute stability and used along with a capillary viscometer to explore slurry rheology. A 72.0 wt. % coal-water slurry was studied by sedimentation, hydrostatic flow, low-shear viscometry and pycnometry. After 42 hours in the sedimentation column the bottom composition remained essentially constant and the slurry flowed from the column under its own head without plug formation. At low shear the slurry acted as a Bingham plastic with a yield stress of 32 dynes/cm^2 and a true viscosity that varied from 53 poise at 25°C to 20 poise at 65°C. The activation energy for low-shear flow was 5.03 Kcal/mol. The intrinsic density of the coal used was 1.22 g/cc.

28074 (CONF-810498—(Vol.2), pp 651-675) **Effect of coal particle size on settling behavior of coal-oil mixtures.** Aikens, A.C.; Ekmann, J.M. (Dept. of Energy, Pittsburgh, PA). 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

Pittsburgh seam coal was pulverized to five different size distributions and used in a series of settling tests at two concentrations and with two No. 6 oils. Data collected during these tests included densities, viscosities, and particle size distributions at three settling column locations. Testing was down over 190 to 200 hours at 140°F. Settling characteristics showed a significant dependence on particle size. As the mean size of the particles increased, so did the rate of settling, determined from changes in density and associated changes in viscosity. Less predictable was the effect on the distribution changes that occur with settling. The data suggest that the large particles begin settling most rapidly, and that as they fall, they initiate the settling of more moderately sized particles that might otherwise remain longer in suspension. This causes both an increase in rate of settling and a rapid drop in mean particle size. With the 30% (by weight) COM's made with PETC No. 6 oil, the stabilizing effects of reduction in particle size seemed to level off below 10μm; further decreases in mean volume diameter may not cause a significant improvement in COM stability. Changes in all parameters with this oil and at this concentration were comparatively rapid. Tests at 40% concentration with PETC No. 6 oil and at 30% concentration with the more viscous Gulf high sulfur oil showed the same particle size effects but at a reduced rate of change.

28075 (CONF-810498—(Vol.2), pp 676-701) **Rheological properties of ultrafine coal-oil mixtures.** Papachristodoulou, G.; Trass, O. (Univ. of Toronto, Ontario). 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

The rheological properties of an ultrafine coal-in-oil mixture (COM) have been studied. A bituminous coal ground to a median size of approximately 10 μm and four types of oil, No. 2, No. 4, light No. 6 and heavy No. 6, were used. Variables investigated were the coal concentration, temperature and the effect of time on viscosity. Direct plots of shear stress vs shear rate were obtained using the Ferranti-Shirley cone and plate viscometer. The COM was classified as a Newtonian fluid at coal concentrations up to 30% by weight and as a Bingham plastic at higher values. The viscosity was found to increase rapidly with coal concentration. For a 50% COM, the relative viscosity, i.e., the ratio of COM to clean oil viscosity was between 10 to 20 while at 60% concentration, it reached the 80 to 100 range. The lower values correspond to lighter oils, No. 2 and No. 4, while the higher ones refer to No. 6 oils. Measurements were made over the temperature range 25 to 90°C. The functional viscosity-temperature relation is the same as for the clean oil (ANSI/ASTM D 341-77), but the COM viscosity is much less sensitive to temperature. The COM yield-stress increases with increasing coal concentration and decreasing temperature. The maximum observed yield stress was 350 N/m^2. No hysteresis loop was observed showing no time dependence of viscosity during the experiment, but the yield stress increased as time elapsed on a long term basis due to network formation.

28076 (CONF-810498—(Vol.2), pp 702-722) **Experimental investigation of preparation and handling of COM in Zhejiang University.** Cen, K.F.; Cao, X.Y.; Yuan, Z.F.; Hong, J.Y.; Lu, C.Q.; Ni, M.J.; Ma, Y.J.; Chen, Y.S. 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

The experimental facilities of preparation, storage, handling and combustion system of COM in Zhejiang University are briefly introduced. Various properties of COM with 10 to 69% of coal powder concentration by weight, such as rheological and vaporization properties, isothermoflow and non-isothermoflow, field of temperature and velocity distribution in heating tube, sedimentation of coal particles, power consumption of propeller type mixer, homogeneity of COM preparation, heat exchange of COM with the coil heater, under temperature variation ranging from 40 to 120°C, etc, were experimentally determined. The relationship of the apparent viscosity μp or the homogeneity factor k and the coefficient of rheological property n as a function of Cw and T may be written in the form of exponential function. It has been found that COM is a kind of pseudoplastic fluid, its flow properties in most of the pipes is laminar flow and its pressure drop may be calculated by laminar flow formula of pseudoplastic fluid with 7.85% standard error.

28077 (CONF-810498—(Vol.2), pp 723-744) **Viscosity and transportation characteristics of coal-oil-slurries.** Rejek, U.; Franke, F.H. (Aachen Technical Univ., German Federal Republic). 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

The transportation behaviour with two types of lignite, two types of bituminous coal and anthracite-oil slurries have been investigated in a circuit loop as a function of temperature, coal concentration, flow velocity and grain size. Fundamentally differing pressure losses of the various coal-oil slurries could be observed with coal concentrations over 30% by weight, in relation to the types of coal and the grain size. At constant velocities and temperature lignite-oil-slurries showed the highest pressure loss and bituminous coal-oil-mixtures the lowest. Open burning coal-oil-suspensions lie in an intermediate range. The influence of grain size on the pressure loss was observed with bituminous and anthracite-oil-slurries and showed the following tendencies: $\Delta p/L$ (o,25-o,5 mm) < $\Delta p/L$ (o-o,5 mm) < $\Delta p/L$ (o-o,25 mm). Viscosity data dermined with samplings taken from the circuit loop and examined with a rotation viscosimeter gave results identical to these based on the pressure losses actually measured in pipes. On the other hand, rheological investigations with laboratory mixed samplings showed higher data

compared with viscosity data determined from the circuit loop. This can be ascribed to the desorption of gases in the porous coal fines, which change the two system coal-oil into a three phase system coal/oil/gas. To avoid an undue increase in viscosity a coal concentration for transportation should not exceed 50% by weight with lignite and 65% by weight with bituminous low volatile coal within a temperature range of 50°C to 80°C.

28078 (CONF-810498—(Vol.2), pp 745-763) **Application to plant operation of laboratory practices used in the characterization of coal-oil mixtures.** Cherry, N.H. (LANKO, Inc., Philadelphia, PA). 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

In this paper, the characterization and development of coal-oil mixtures are discussed with the view toward their use in plant size operations. Stability and rheological properties of these mixtures are first described with respect to laboratory procedures. Consideration is given to the influence on these properties by coal particle size, coal concentration, oil viscosity, water concentration, and chemical additives. Techniques for chemical additive selection are discussed in detail. The application of these laboratory determined properties of coal-oil mixtures is then discussed with respect to the componenets of a full scale plant. This is done for the system components of mixing, pumping, storing, heating, and of nozzle acceptance. Preferential procedures during plant start up are discussed for both COM constituents and system components. COM parameter ranges are discussed for the system components of a full scale plant. In general it is concluded that present day laboratory practices are adequate to insure proper operation of a COM preparation plant.

28079 (DOE/ET/10487—T1) **Coal anion structure and chemistry of coal alkylation. Final report, March 1, 1979-February 29, 1980.** Stock, L.M. (Chicago Univ., IL (USA)). 1980. Contract AC22-77ET10487. 40p. (COO—4227-12). NTIS, PC A03/MF A01. Order Number DE81025500.

In accord with Task 1, some ether cleavage reactions were carried out in two different media - potassium/naphthalene/tetrahydrofuran and potassium/ ammonia - so that the merits and demerits of the two methods could be compared. Preliminary results suggest that both systems yield the same products, and that the ammonia medium is more convenient to work with, because of the absence of by-products such as reduced naphthalenes and tetralin. Dialkyl ethers were found to be least reactive compounds while the benzyl and phenyl ethers were found to be most reactive, as would be expected. The reductive alkylation of coal was carried out in ammonia at 25°C. The tetrahydrofuran solubility of the reaction product was surprisingly low. We have obtained additional $^{13}C\{^1H\}$ nmr data for tetrahydrofuran-soluble butylated coal and some model compounds; obtained additional Styragel(R) chromatography data of tetrahydrofuran-soluble coal labelled with 98%-enriched butyl-1,1-d_9 iodide; and obtained ^2D nmr spectra of all the deuterium-labelled, tetrahydrofuran-soluble coal products. In accord with Task 4, we have undertaken a review of the information now available concerning the nature of Illinois No. 6 coal. Also, the effects of organic additives on the exchange reactions between tetralin-d_{12} and diphenyl-methane and on the thermal cleavage reactions of several model compounds in tetralin were investigated to probe the relationship between structure and reactivity. The exchange reaction can be accelerated by coal, asphaltene-preasphaltene fractions derived from coal, compounds with labile bonds, or compounds which can be reduced readily. The pyridine-insoluble coal product, acids, and bases are inactive toward the exchange reaction.

28080 (DOE/ET/10626—T1) **Chemistry and structure of coal-derived asphaltenes and preasphaltenes. Quarterly progress report, July-September 1980.** Yen, T.F. (University of Southern California, Los Angeles (USA)). 1980. Contract AC22-76ET10626. 22p. (FE—2031-18). NTIS, PC A02/MF A01. Order Number DE81025932.

In order to determine the role of oxygen in altering the microstructure of the residues and the differences in reaction paths during heat-treatment, two asphaltenes, Catalytic Incorporated and FMC-COED, were pyrolysed and the residues studied using Fourier Transform Infra-red (FTIR) analysis. These were pyrolyzed under the standard conditions (N_2 purge, 13°C/hr to 360°C, 5°C/hr to 500°C) and samples were taken at appropriate temperature intervals. The residues were fractionated into oil-resin, asphaltene, preasphaltene and mesophase and transformation curves obtained. Elemental analysis of the residue fractions was done for use in conjuction with FTIR analysis to get structural information. The conclusions from this study are: (1) the pyrolysis reactions are predominantly loss of alkyl and hydroxyl groups; (2) the FMC-COED condensation reactions lead to a peri-condensed material; (3) the oxygen stays in the pyrolysis residue as a ketone and ether for FMC-COED and as a ketone for Catalytic Inc; and (4) in the FMC-COED which starts out with a large amount of oxygen and forms a fine isotropic mesophase, the reactions of cross linking through the polar groups to form ethers do occur and for Catalytic Incorporated which forms a coarse mesophase the oxygen residue remains as ketone groups.

28081 (DOE/PC/30230—T2) **Phase-equilibrium properties of coal-derived liquids. Technical progress report, January-June 1981.** Yesavage, V.F.; Kidnay, A.J. (Colorado School of Mines, Golden (USA). Dept. of Chemical and Petroleum Refining Engineering). 1 Jul 1981. Contract FG22-80PC30230. 11p. NTIS, PC A02/MF A01. Order Number DE81027106.

On July 1, 1980, work was initiated on a program for experimental vapor liquid equilibrium measurements on coal derived liquids. During the last six months design of the equilibrium flash vaporization system was completed and all major equipment was delivered. Most of the construction work of the system was also completed. Construction and evaluation of the equipment should be completed by the end of the summer. Work was also started on the gas-liquid chromatography analytical procedures. Coal derived liquids are a new and vital class of industrial compounds for which there are limited thermodynamic data. The principal investigators have conducted a program in the measurement and correlation of the enthalpy of coal derived liquids. Programs have also been undertaken to measure volumetric properties and K values of light gas-model compound systems and to measure dew points, vapor pressures and hydrogen solubilities in model compound and coal derived liquid systems. The objective of the present study is to measure equilibrium K values of coal derived liquids and model compounds representative of coal liquids, and to use the results in the development of engineering correlations. The program is divided into three major areas: (1) design, construction, and evaluation of an equilibrium flash vaporization system for temperatures between 70 and 700°F, at pressures up to 2000 psia; (2) measurements on samples of both coal derived liquids and mixtures of model compounds; and (3) preparation of engineering correlations for the measured K values and vapor liquid equilibria.

28082 (DOE/PC/30252—T4) **Hydrogen bonding in asphaltenes and coal liquids. Quarterly report, May 1, 1981-July 31, 1981.** Li, N.C.; Jones, L.; Yaggi, N.F. (Duquesne Univ., Pittsburgh, PA (USA). Dept. of Chemistry). 1981. Contract AC22-80PC30252. 26p. NTIS, PC A03/MF A01. Order Number DE81027880.

Coal-derived liquids are very susceptible to oxidative degradation. Oxygen and temperature exert a dramatic effect on enhancing the viscosity of coal-derived fuels, and a free-radical mechanism is an obvious choice for the mechanism of this noted oxidative degradation. In the present study, several different phenols were added to blends consisting of two different ratios of SRC I and SRC II middle distillate: 20/80 and 30/70 by weight. The objective of this research is to study the effect of phenols on the aging of the SRC blends. It has been found that upon the addition of phenol itself, the original hydrogen bonding between the acidic and basic functional groups in the coal-derived liquids is apparently disrupted because the added phenol can now interact with the proton-accepting species in liquids, thus, leading to a lower viscosity. When anisole (which contains no hydroxyl group) is added instead of phenol, the effect of slowing down the aging process is much smaller. o-Phenylphenol is a hindered phenol, and the effect on the aging process is intermediate between anisole and phenol.

28083 (EPRI-EA—1822) Trace-element and phase relations in fly ash. Hulett, L.D.; Weinberger, A.J.; Ferguson, N.M.; Northcutt, K.J.; Lyon, W.S. (Oak Ridge National Lab., TN (USA)). May 1981. Contract W-7405-ENG-26. 70p. NTIS, PC A04/MF A01. Order Number DE81028555.

Chemical forms of elements have been studied in fly ash specimens collected from four Tennessee Valley Authority steam plants. Matrix components have been isolated and individually analyzed to determine trace element distributions. After particle sizing and extraction of magnetic components, the aluminosilicate phases were etched in 1% HF to remove glasses comingled with mullite and quartz. Neutron activation and atomic absorption analyses showed that most of the +1- and +2-valent elements, rare earths, and certain transition metals were concentrated in the glass phases. Cr, V, Ti, Fe, Ga, and Zr, which are trivalent and tetravalent, were concentrated in the crystal phases. X-ray diffraction and elemental analyses show that the main components of the magnetic phase are ferrite compounds with compositions of approximately $Fe_{2.3}Al_{0.7}O_4$. First-row transition elements, V, Cr, Mn, Co, Cu, Ni, and Zn are concentrated by factors as high as 50 in the magnetic phases. This infers that they occur as isomorphic substitutions in the magnetic spinel lattice since such compounds are well known. Because the spinel is magnetic, a magnetic separation could be used to remove spinel, along with its associated transition metals. Scanning electron microscopy studies of mullite phases remaining after 1% etching suggest that they have resource value. As mullite and quartz crystallize during the solidification of fly ash particles, they purify themselves of trace elements by freezing them out into interstitial glass phases. An analytic scheme for routine chemical specification and pollution hazard assessment of fly ash is suggested. Studies of fly ash exposed to sluice pond waters show tht iron in the magnetic spinel phases is oxidized and subsequently adsorbed on alumino-silicate and other particles. Arsenic and molybdenum are translocated and concentrated into these iron-rich surface phases.

28084 Fracture mechanics model for Pittsburgh coal. Powell, W.R.; Khan, S.; Ramsey, D.G.; Gmeindl, F. (WVa Univ, Morgantown). *American Society of Mechanical Engineers, [Paper] ;* No. 81-Pet-16, vp(1980).

Methane recovered from coal seams is an attractive alternative fuel to natural gas. Hydraulic fracturing is usually necessary to increase methane flow rates. Understanding, predicting and controlling the hydraulic fractures requires knowledge of the fracture mechanics of coal. Experimental results are used to evaluate two fracture mechanics models for Pittsburgh coal, the critical strain energy density and critical stress criteria for crack propagation. 12 refs.

0108 Waste Management

REFER ALSO TO CITATION(S) 28083, 28146, 28616, 28617, 28618, 28619, 28620, 28621, 28622, 28623, 28624, 28625, 28626, 28627, 28628, 28629, 28630, 28631, 28632, 28633, 28634, 28635, 29157

28085 (CONF-810498—(Vol.1), pp 217-226) **Sulfur dioxide removal in the combustion of coal/oil/water emulsions.** Dooher, J.P.; Gilmartin, B.; Genberg, R. (Adelphi Univ., Garden City, NY). 1981. NTIS, PC A20/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

This paper presents results on the combustion of coal/ # 4 oil/water emulsions with alkaline absorbents added for the removal of sulfur dioxide from the stack gases. The Cleaver Brooks 350 hp fire-tube boiler-furnace is described, along with the combustion instrumentation and the Norfelt Dust Collector. Coal/oil/water emulsions burn with thermal effeciencies close to that obtained with neat oil. When soda ash, limestone, dolomite, or hydrated lime are added to the emulsions for sulfur dioxide removal, the thermal efficiency is slightly reduced. Soda ash has proved the most efficient additive with over 90 % SO_2 removal. Different nozzle designs for the combustion of these mixtures are described. Ash deposition, which is a problem with high solids content fuels, has been reduced with the use of soot blowers. The effect of the installation of a baghouse is discussed. Through the use of alkaline additives, along with modifications to an oil burning furnace, coal/oil/water emulsions can be burned efficiently and cleanly.

28086 (CONF-810498—(Vol.2), pp 480-493) **Pilot electrostatic percipitator test results Sanford COM project Florida Power and Light Company.** Burgess, R.J. (Florida Power and Light Co., Miami); Lane, W.R.; Takvoryzn, N.E. 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

Florida Power and Light Company has undertaken a comprehensive, full scale effort to study COM firing in a 400 MW oil designed boiler at its Sanford Unit No. 4. A pilot electrostatic precipitator (EP) has been an integral part of this project for investigating the collectability of flyash. The study was made on a slipstream of about 3000 ACFM, taken downstream of the air heater. Numerous collection efficiency tests were performed with the boiler firing COM at full load whenever possible. The concentration of coal by weight in the COM varied between 20% and 50%. For a few tests the boiler was fired with oil only. Particulate emissions of 0.01 to 0.1 gr/SCF have been obtained. The particulate collection efficiency depends on specific collection area (SCA), power input, dust characteristics, etc. This paper will present the trends in the pilot test results and discuss the critical factors to be considered for full scale EP's on COM firing boilers.

28087 (CONF-810701—6) Development of a mechanistically based computer simulation of nitrogen oxide absorption in packed towers. Counce, R.M. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 7p. NTIS, PC A02/MF A01. Order Number DE81025632.

From Computer simulation conference; Washington, DC, USA (15 Jul 1981).

A computer simulation for nitrogen oxide (NO/sub x/) scrubbing in packed towers was developed for use in process design and process control. This simulation implements a mechanistically based mathematical model, which was formulated from (1) an exhaustive literature review; (2) previous NO/sub x/ scrubbing experience with sieve-plate towers; and (3) comparisons of sequential sets of experiments. Nitrogen oxide scrubbing is characterized by simultaneous absorption and desorption phenomena: the model development is based on experiments designed to feature these two phenomena. The model was then successfully tested in experiments designed to put it in jeopardy.

28088 (DOE/ET/11070—T4) Reconnaissance and processing of impounded coal wastes. Quarterly report, April 1, 1981-June 30, 1981. Hilleke, F.; Browning, J.S. (Alabama Univ., University (USA). Mineral Resources Inst.). 1981. Contract AC22-78ET11070. 25p. NTIS, PC A02/MF A01. Order Number DE81026241.

The purpose of the study is to sample, test and analyze coal impoundments in Alabama to determine the quantity of coal in place, and the quantity, and quality of recoverable coal in each impoundment. A second objective of the work is to sample the washery wastes currently discharging into the impoundments, and to determine the quantity and quality of coal recoverable. Data are presented on 14 waste coal impoundments with proven reserves of 11,515,373 tons of raw coal from which 4,697,174 tons of clean coal can be recovered. During the third quarter of FY 1981, exploration of 4 of these waste fine coal impoundments were completed. Summary data on these reserves are included. (DMC)

28089 (EPA—600/9-81-019a, pp 49-83) **FGD economics in 1980.** McGlamery, G.G.; O'Brien, W.E.; Stephenson, C.D.; Veitch, J.D. (Tennessee Valley Authority, Muscle Shoals, AL). Apr 1981. NTIS.

From Symposium on flue gas desulfurization; Houston, TX, USA (28 Oct 1980).

Presented in this paper is a review of recent results from EPA-sponsored flue gas desulfurization and byproduct/waste disposal economic evaluations prepared by TVA. Included are a summary of comparative capital investments and annual revenue requirements from a three-phase effort to evaluate the leading FGD process, and similar results from three phases of sludge disposal studies. Data from a 1985 projection of FGD byproduct sulfur/sulfuric acid marketing potential are given. A new series of FGD process evaluations is also previewed including a set of updated evaluation premises which will be utilized in the early 1980's. Ex-

amples of the effects of the revised premises on limestone scrubbing economics are shown. Finally, results are provided from a recent evaluation of limestone scrubbing in a spray tower using adipic acid, forced oxidation, an gypsum disposal by stacking.

28090 **(ORNL/MIT—331) Aluminum recovery from fly ash and shale-retort wastes.** Plawsky, J.L.; Helling, R.K.; Tsui, M.E. (Massachusetts Inst. of Tech., Oak Ridge, TN (USA). School of Chemical Engineering Practice). Jul 1981. Contract W-7405-ENG-26. 72p. NTIS, PC A04/MF A01. Order Number DE81027675.

The sparge-crystallization step in a proposed process for aluminum recovery from fly ash was studied. The effect of various feeds and HCl concentration on the solubility of six metal ions was investigated, and the yield and purity of the crystals obtained. Significant improvements in data consistency were obtained over previous work on this system. Multistage crystallization and washing will be necessary to achieve removal of K and Mg to meet product specification. The replacement of ferric ion with ferrous ion produced an increase in Mg solubility, leading to the conclusion that more work is required with ferrous feeds and with multistage crystallizations. Experiments with leachate from oil-shale-retort residues produced 99.87% aluminum purity. A predictive correlation proposed by Meissner was used to predict solubilities of pure and mixed salts in hydrochloric acid solutions. Modification of the correlation's parameters yielded excellent agreement with theory for the $AlCl_3$-HCl system.

28091 **Catalytic reduction of sulfur dioxide.** Moody, D.C.; Ryan, R.R.; Salazar, K.V. (Los Alamos National Lab., NM). *Journal of Catalysis ;* 70: No. 1, 221-224(Jul 1981).

Many processes have been utilized with varying degrees of success for removal of sulfur dioxide from flue gases. Quite a few more have been proposed. One type of process that would appear quite attractive is the reduction of the SO_2 to sulfur. The present work was undertaken to examine the effect of using an extremely active hydrogenation catalyst to promote the reduction of SO_2 with H_2 at low enough temperatures such that H_2S formation could be minimized. Ruthenium on γ-alumina was examined and found to be quite active at temperatures as low as 150°C. These results are discussed in this paper.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 28059, 28070, 28133, 28155, 28590, 28766, 29208, 29209, 29233, 29240, 29243, 29253

28092 **(DOE/EIS—0073-Vol.1) Solvent-Refined Coal-I Demonstration Project. Final Environmental Impact Statement, Volume 1 of 2.** (Department of Energy, Oak Ridge, TN (USA). Oak Ridge Operations Office). Jul 1981. 700p. NTIS, PC E08/MF E08. Order Number DE81025983.

The Statement asseses the potential environmental impacts associated with the construction and operation of a 6000-tpsd-capacity coal liquefaction facility at Newman, Kentucky which will demonstrate the technical operability, economic viability, and environmental acceptability of an SRC-I process. Impacts assessed include the following: effects of the project on occupational and public health resulting from the production and use of SRC products; potential impacts on terrestrial and aquatic ecology, including state and federally declared threatened or endangered species; potential and expected impacts on land use; withdrawal and alteration of prime agricultural land; projected effects on flood-plain and wetland areas; potential impacts on surface water and groundwater; potential impacts on ambient air quality; potential change of the cultural landscape; potential impacts on sites of archaeological significance; and changes to existing economic and social characteristics of the site area. Additionally, the statement presents an assessment of potential long-range and cumulative impacts of a future commercial expansion of the proposed facility at the proposed site to an approximately 30,000-tpsd capacity. A construction and operational monitoring plan to assess the effectiveness of the planned mitigatory measures for the duration of the demonstration phase is also presented. In assessing the potential environmental impacts of the proposed action, several programmatic and project alternatives are considered and evaluated. The range of alternatives assessed includes proceeding with the proposed action, modifying the action and subsequently continuing the project, delaying the action, and terminating the contract with no further action. Impacts of contructing and operating the proposed facility at two alternative sites are evaluated. Vol. 1 includes the formal statement and comments received with responses.

28093 **(DOE/EIS—0073-Vol.2) Solvent-Refined Coal-I Demonstration Project. Final Environmental Impact Statement, Volume 2 of 2.** (Department of Energy, Oak Ridge, TN (USA). Oak Ridge Operations Office). Jul 1981. 480p. NTIS, PC E05/MF E05. Order Number DE81027676.

For abstract of EIS see abstract of Vol. 1. Vol. 2 consists of 33 appendices dealing with site selection, plant design, chemical effluents, land use, hydrology, water quality, aquatic ecology, terrestrial ecology, geology, soils, groundwater, leaching tests on coal and products and solid wastes, environmental plan, air quality, socio-economic factors, carbon dioxides, permits, hazards, health hazards, transport and materials handling of coal, erosion, toxic materials, impact of associated coal mine, use of prime farm land, etc. (LTN)

28094 **(NP—1903439) Role of arthropods in developing soils on mine spoils. Final report.** Whitford, W.G.; Elkins, N.Z.; Parker, L.W. (New Mexico State Univ., Las Cruces (USA). Dept. of Biology). Jun 1981. 42p. (EMD—2-68-3212). University of New Mexico, New Mexico Energy Inst., Albuquerque. Order Number DE81903439.

In laboratory microcosms of coal mine spoil amended with bark and wood chips, the activity of termites increased organic matter and increased total nitrogen. Termite survival was reduced in microcosms with spoil and paper or straw amendments. Field studies evaluating the efficacy of organic amendments in developing a soil biota showed that decomposition rates of wood chip-bark amended spoil were the same as unmined soil and that decomposition rates were lower than all other mulch-spoil combinations. Wood and bark amended-spoil had the highest density and diversity of soil fauna. Top dressing spoils with borrow soil did not improve any of the soil biological parameters measured. Based on these data it was recommended that reclamation procedures be changed to eliminate borrow soil top-dressing and that wood removed from mined areas be returned to the contoured spoil as wood chip amendment in addition to straw mulch.

28095 **(UCRL—85880) Groundwater contamination near the Hoe Creek UCG experiments.** Wang, F.T.; Mead, S.W.; Stuermer, D.H. (Lawrence Livermore National Lab., CA (USA)). 1981. Contract W-7405-ENG-48. 23p. (CONF-810923—3). NTIS, PC A02/MF A01. Order Number DE81026113.

From 7. underground coal conversion symposium; Fallen Leaf Lake, CA, USA (8 Sep 1981).

It has been shown that underground coal gasification (UCG) may introduce a broad range of residual gasification products into the groundwater of a coal aquifer. Sorption of many contaminants by the coal itself is an important factor in restricting the migration of these contaminants in the groundwater. However, our field studies, conducted at Lawrence Livermore National Laboratory's Hoe Creek site, have shown that sorption of organic compounds by coal is not as effective as expected, perhaps because the coal surface area is limited. Furthermore, if severe roof collapse has taken place during gasification, non-coal aquifers located above the gasified coal seam may be interconnected with the coal aquifer, and contaminants may enter these non-coal aquifers, in which sorption is even less effective. The Hoe Creek II and III experiments have provided us with opportunities to study the contamination of a sand aquifer located above a gasified coal seam in a hydrological recharge area. Our preliminary results indicate that the water in the overlying sand aquifer is much less contaminated with organic compounds than the water in the gasified coal aquifer. In conducting these field investigations, we have also learned valuable lessons concerning groundwater monitoring. A suggested monitoring strategy will be discussed.

28096 (UCRL—86437) Computer models to support investigations of surface subsidence and associated ground motion induced by underground coal gasification. Langland, R.T.; Trent, B.C. (Lawrence Livermore National Lab., CA (USA); Science Applications, Inc., Steamboat Springs, CO (USA)). 1981. Contract W-7405-ENG-48. 14p. (CONF-810923—1). NTIS, PC A02/MF A01. Order Number DE81027131.

From 7. underground coal conversion symposium; Fallen Leaf Lake, CA, USA (8 Sep 1981).

Two computer codes compare surface subsidence induced by underground coal gasification at Hoe Creek, Wyoming, and Centralia, Washington. Calculations with the STEALTH explicit finite-difference code are shown to match equivalent, implicit finite-element method solutions for the removal of underground material. Effects of removing roof material, varying elastic constants, investigating thermal shrinkage, and burning multiple coal seams are studied. A coupled, finite-difference continuum rigid-block caving code is used to model underground opening behavior. Numerical techniques agree qualitatively with empirical studies but, so far, underpredict ground surface displacement. The two methods, numerical and empirical, are most effective when used together. It is recommended that the thermal characteristics of coal measure rock be investigated and that additional calculations be carried out to longer times so that cooling influences can be modeled.

0110 Reserves And Exploration

28097 (DOE/FE/05110—T1) Peat-resource estimation in New York State. First quarterly report, 1 April 1981-30 June 1981. Peterson, J.M. (New York State Energy Research and Development Authority, Albany (USA)). Jul 1981. Contract FG01-81FE05110. 11p. NTIS, PC A02/MF A01. Order Number DE81027551.

This report discusses the progress made on the New York State peat inventory as of July 25, 1981. Achievements and results in the following areas are reported: collection of data; identification of protected land; standardization of mapping methods; index of all peat bogs; airphoto interpretation; drafting of maps; field crew mobilization; engineering time used; and problems incurred. (DMC)

28098 (DOE/FE/20036—1) Planning a comprehensive program for exploration of the anthracite deposits of the Narragansett Basin of Massachusetts and Rhode Island. Final report, Phase I and II. Skehan, J.W. (Rhode Island Univ., Kingston (USA)). Feb 1981. Contract AC01-79RA20036. 131p. NTIS, PC A07/MF A01. Order Number DE81028490.

DOE funded the development of a core drilling program plan for the Basin at the University of Rhode Island in 1979. The original intent was to drill 660 holes throughout the Basin. Due to inflation the funding level had to be increased to complete the program. The technical methodology consisted of developing criteria for location of drill sites, defining the core logging scheme and the types of analyses required to define coal quality and other geologic parameters. The Narragansett Basin has undergone a complex history of sedimentations, structural deformations, metamorphisms and plutonism. Coal deposits occur in a sporadic fashion throughout the Basin with little continuity as to the type of deposit and the quality of coal thus making it difficult, perhaps very expensive and risky, to base a drilling program solely on stepping out from known outcrops and coal occurrences. The combination of understanding the original depositional environment, its subsequent deformation in addition to stepping out from known coal occurrences, is believed to be the most efficient basis for developing a comprehensive drilling program plan for the Basin. This limited exploration program has produced resource estimates of 11.35 million tons of anthracite material in the eastern and 5.73 in the western part of the Portsmouth, Rhode Island, area and 4.2 million tons in Plainville, Massachusetts. These estimates are based on USGS recommended methods for resource determination. The cost of finding this material, based on the cost of the contracts, comes out to be approximately 1.5 cents per ton.

0120 Mining

REFER ALSO TO CITATION(S) 28084, 28939, 29134

28099 (DOE/ET/12482—1(Vol.1)) Development of large diameter drilling equipment (Phase II). Volume II: bit feature test. Final report. (Fenix and Scisson, Inc., Tulsa, OK (USA)). Mar 1981. Contract AC22-76ET12482. 336p. NTIS, PC A15/MF A01. Order Number DE81027840.

This Phase II final report (Vol I, II and III) discusses in detail the design of a large diameter drilling system that is capable of rotary drilling 20 foot diameter shafts to 2000 feet and lining the shaft with concrete without using personnel underground. The time and cost of drilling and lining a 20 ft diameter shaft to 1000 ft in severe geological conditions is estimated to be 104 days and about $2300 per foot. The machine is designed to operate in remote locations, is non-permit load, truck transportable, and does not rely on utility companies for electrical power. The report is presented in two volumes. Volume I includes information on drilling machine and lining system, system design parameters and descriptions, economic analysis and operation and maintenance procedures. Volume II contains data, conclusions, and recommendations from tests performed to determine the relative cleaning efficiencies of three bit configurations: CUTTERS ONLY, CUTTER PUMPS, and JET ASSIST. Volume III contains detailed design and testing data for precast segmented lining system.

28100 (DOE/ET/12482—1(Vol.2)) Development of large diameter drilling equipment (Phase II). Volume II: bit feature test. Final report. (Fenix and Scisson, Inc., Tulsa, OK (USA)). Mar 1981. Contract AC22-76ET12482. 240p. NTIS, PC A11/MF A01. Order Number DE81027651.

The comparative test program provided data to evaluate three bit configureations: CUTTERS ONLY, JET ASSIST, and CUTTER PUMPS, in order to recommend one configuration for the LDDM. The bits were evaluated in terms of their cleanability; how much aggregate was removed and how much regrinding occurred. These were measured by visual observation and by statistical analysis. Test No. 5, according to visual observation, cleared the test tank floor of the most aggregate. Test No. 5 was conducted with CUTTER PUMPS, at 10 rpm, and 3400 gpm. Tests Nos. 12 and 7 were confirmation tests and did equally well in cleaning the floor of aggregate. This ranking suggests that the CUTTER PUMPS configuration at 10 rpm removed more material than the other bit feature arrangements. Test No. 5 also had the highest penetration rate. Tests Nos. 12 and 7 had the third and fourth highest penetration rate. Test No. 4 had the second highest penetration rate, but it ranked among the lowest in terms of material removed. So, penetration rate comparison also suggests that CUTTER PUMPS, at 10 rpm, is more effective than the other bit feature arrangements. The results may have been different if more tests had been conducted. Both JET ASSIST and CUTTER PUMPS were statistically better than CUTTERS ONLY. Statistical analysis also suggests that higher rpm and higher flow rates could be a factor in improving bottom-hole cleaning.

28101 (DOE/ET/12485—T1) Development and test of an underground auger panel extraction system. Final report. Ritchey, J. (FMC Corp., Santa Clara, CA (USA). Engineered Systems Div.). Mar 1981. Contract AC01-75ET12485. 198p. NTIS, PC A09/MF A01. Order Number DE81027054.

From June 1975 to March 1981, the Engineered Systems Division of FMC Corporation engaged in the development and testing of two prototype underground augering machines, first under contract to the US Department of the Interior, Burea of Mines and later to the US Department of Energy. Actual underground testing of the first machine (a modified Coalbadger manufactured at the time by Badger Manufacturing Company) was in 1976. Shift production averaged 39 tons. The second machine, highly modified from the Coalbadger and built at FMC, was in service in late 1978 and early 1979. Average shift production with this machine increased to 88 tons. Boreholes up to 110 feet deep were drilled with these machines, a hole was successfully backreamed from its original 42-inch diameter to 48 inches, and several experiments were performed to determine drilling horsepower. Consolidation Coal Company's Ireland Mine near Moundsville, West Virginia, pro-

vided the demonstration site for both machines. This mine is in the Pittsburgh Number 8 coal seam. It was concluded that underground augering of coal is a viable means of extracting coal from certain difficult areas of many mines. Future machines must have improvements which will result in less downtime, and average production must increase to 125 tons per shift or more to be attractively profitable.

28102 **(DOE/ET/12532—T1) Evaluation of longwall industrial engineering data. Volume 1. Text. Final technical report.** Pimentel, R.A.; Urie, J.T.; Douglas, W.J. (Ketron, Inc., Wayne, PA (USA)). Apr 1981. Contract AM01-77ET-12532. 145p. (FE—8915(11)-1). NTIS, PC A07/MF A01. Order Number DE81026214.

An analysis was undertaken of an existing US Longwall Industrial Engineering data base to determine the components most in need of improvement and to investigate the performance of several mathematical models in describing the delay occurrence in longwall faces. The three longwall components identified as the major sources of production delays are: the shearer; the face conveyor; and the outby haulage system. These three components typically account fo 75% of all downtime. The major delay types for these components were identified. Recommendations are presented for further research to eliminate these delay sources. The delay frequency and duration distributions were found to be so skewed that the arithmetic mean loses its value of being typical. The use of the median to convey the idea of a typical observation is recommended. Mathematical models could provide a more comprehensive description of downtime behavior. However, the curve fitting tests performed so far were unsuccessful. Recommendations are presented for continued research in this area.

28103 **(DOE/ET/12532—T2) Evaluation of Longwall industrial engineering data. Final technical report.** Pimentel, R.A.; Urie, J.T.; Douglas, W.J. (Ketron, Inc., Wayne, PA (USA)). 24 Apr 1981. Contract AM01-77ET-12532. 367p. NTIS, PC A16/MF A01. Order Number DE81025974.

28104 **(DOE/ET/12532—T3) Advanced development analysis model for evaluating new mining technology. Final technical report.** Kohler, J.L.; Davis, R.P.; English, L.M.; Douglas, W.J. (Ketron, Inc., Wayne, PA (USA)). Feb 1981. Contract AM01-77ET-12532. 368p. (FE—8915-1). NTIS, PC A17/MF A01. Order Number DE81024260.

The objective of this project was to develop a quantitative model for evaluating the production and financial impact of various mining equipment types and methodologies. The Advanced Development Analysis Model (ADAM/1) was developed, tested, and utilized to study the results of applying existing technology and advanced technology to various mining scenarios. Six scenarios were selected to represent areas and conditions where coal would be mined in the 1980's. The equipment types and methodologies selected for existing technology are consistent with current practices, while those selected for advanced technology reflect current thinking about technology available in the 1980's. The utility of the ADAM/1 model was demonstrated and validated. The results of the study demonstrate the potential of advanced development equipment for increasing the production capacity of a mine per dollar invested, improving productivity, and achieving returns on investment which are reasonably close to those attained with current technology.

0130 Transport And Handling

REFER ALSO TO CITATION(S) 28028, 28078, 28128, 28129, 28132, 28135, 28141, 28584, 28585, 28589, 28814

28105 **(CONF-810498—(Vol.1)) Third international symposium on coal-oil mixture combustion.** (Department of Energy, Pittsburgh, PA (USA). Pittsburgh Energy Technology Center). 1981. 473p. NTIS, PC A20/MF A01. Order Number DE81027262.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

The proceedings of this symposium is published in 2 volumes. This volume contains papers presented in sessions I through VIII. Session topics are: international overviews; demonstration projects; coal-oil mixture (COM) preparation and stabilization; COM equipment; COM rheology; COM commercialization and economics; and COM combustion and emissions. Separate abstracts for individual papers have been prepared for inclusion in the Energy Data Base. (DMC)

28106 (CONF-810498—(Vol.1), pp 124-140) **Result of the Salem Harbor coal-oil mixture demonstration.** Dunn, R.M.; Batra, S.K. (New England Power Service Co., Westborough, MA). 1981. NTIS, PC A20/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

A COM production plant was completed and placed in operation in 1979. The original burners on an 80 MW front fired Babcock & Wilcox unit, designed for coal firing but converted to oil, were replaced with low pressure, air atomized burners. Initial COM blending encountered pulverized coal bin feed problems requiring modifications. When coal concentration was increased to 30%, stack particulate emissions exceeded regulatory limits and coal concentration was reduced. A continuous COM blending and storage facility has been operated with few difficulties utilizing 200 mesh blended West Virginia coal mixed with a stabilizing surfactant and oil. After initial burner adjustments, COM was burned with high levels of unburned carbon which have been attributed to increased asphaltenes in the fuel oil and poor fuel atomization. Flames were bright and stable, however, and burner turndown has been achieved to levels below 50% without difficulty. Moderate burner tip erosion was experienced and hardened mateials were installed. Significant erosion of other equipment exposed to COM has not been found. Settling of coal particles in storage and in piping systems has not been detected. Techniques to improve combustion, fuel atomization and precipitator collection efficiency were investigated. Erosion resistant alloy burner tips were tested.

28107 (CONF-810498—(Vol.1), pp 158-176) **Trial test of burning COM in an oil-fired boiler of 2000 kW turbo-generator set.** 1981. NTIS, PC A20/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

In order to change the present structure of primary energy resources and reduce the petroleum consumption in China, the possibility of burning COM in original oil-fired equipment, which could not burn coal due to some reasons, should be studied. The retrofit requirements and technological influences should also be examined. Research work on COM should be intimately connected with the pecularities of Chinese coal and fuel oil. The research and development program must be carried on from bench scale, pilot plant, demonstrating plant to commercial site. The final result, with the using of COM on oil-fired equipment, will be not only saving of fuel oil but also satisfying process technology to a certain extent. Thus, we emphasize our attention on COM viscosity, the sedimentation of pulverized coal after mechanical agitating and mixing with residual oil, and the mechanism of atomizing and combustion of COM. Due to lack of suitable additives at present, proper storage and measurement of coal concentration in COM were studied. Capacitance method has been adopted and used burning the transportation of COM. Special heater, atomizer, and register were designed for COM burning. A simplified COM preparation system was erected, and COM was used in an original oil-fired 15 t/hr boiler for 2000 kW turbo-generator set. The boiler designed furnace volume heat release rate is 230 x 10^3 Kcal/m^3-hr. When using COM to coal concentration of 40% by weight, there is no reduction of rated load of generator set, but with only a little decrease in boiler efficiency. Coal pulverizing system will be erected in 1981, then more tests on various coals and fuel oils will be performed.

28108 (CONF-810498—(Vol.1), pp 210-216) **Use of selective agglomeration in the preparation of coal-oil mixtures (COM).** Idle, K.; Green, G.; Blejde, W.; Armstrong, L.W.; Smitham, J.B.; Nicol, S.K. (Broken Hill Proprietary Co., Ltd., Australia). 1981. NTIS, PC A20/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

The motivation for using COM is well established. As part of the Broken Hill Proprietary Company Limited program to reduce oil usage, the Open Hearth Furnaces at the Port Kembla

Steelworks have been converted to fire COM. This conversion was conducted in two stages. The first stage consisted of combustion trails lasting up to one month during which over 90,000 tonnes of steel were produced in furnaces successfully firing COM. The second stage consisted of laboratory and pilot scale trials to demonstrate that fine coal could be successfully agglomerated using heavy oil in the Selective Agglomeration Process. In essence this Process involves adding oil to a stirred slurry of coal of the desired size. With suitable agitation conditions the coal and oil separate into spherical agglomerates which can be screened from the liberated mineral matter which remains suspended in the water. Thus Selective Agglomeration produces low ash agglomerates which may be stored, handled and made up into COM on demand. In this way the difficulties of preparing COM with long term stability are avoided. A plant designed to agglomerate 300,000 tonnes per year of minus 100 μm coal from the Steelwork's washery is scheduled for completion in mid-1981.

28109 (CONF-810498—(Vol.1), pp 262-289) **Status of the Occidental coal-oil-mixture program.** Knell, E.W.; Bauer, H.F. (Occidental Research Corp., Irvine, CA). 1981. NTIS, PC A20/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

COM Energy, Inc., a subsidiary of Occidental Petroleum Corporation has constructed a demonstration plant capable of producing one million barrels-per-year of COM. The company plans to locate this commerical scale unit in Northern Florida and commence operation in mid-1981. COM will be distributed to customers in the region as a substitute for fuel oil presently burned in boilers and kilns. As the market for COM grows, COM Energy, Inc. expects to build additional units and ultimately large permanent plants of up to 50,000 barrels-per-day capacity, both in this country and overseas. Laboratory characterization and subscale combustion tests are being performed to ensure that the COM has acceptable pumping, storage, and burning characteristics. State-of-the-art stabilization techniques have been tested in the laboratory and incorporated in the demonstration plant. This paper addresses the overall status and technological aspects of the project including a description of the process and the supporting R & D program.

28110 (CONF-810498—(Vol.1), pp 309-318) **Scenario for regional COM preparation.** Holbrook, W.D. 1981. NTIS, PC A20/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

A conceptual regional COM preparation facility is projected on the eastern coast of the United States at a location of coal export and petroleum terminal activity. An operating plan, comprising sourcing, handling and storage of the coal and oil, and preparation, handling and shipping of the COM is presented for a modular concept plant. The purpose of developing this scenario is to examine the realities of large-scale COM commercialization assuming viable technology for preparation and fuel stability. The insight gained by this detailed examination of the operational mechanics of regional COM supply is intended to assist potential fuel users in evaluating the prospects for near-term COM conversion. Based on this analysis, large-scale COM supply using conventional fuels transportation infrastructure is seen to have near-term feasibility and is not limited by operational considerations. A zone of economic viability is developed within which delivered COM prices provide savings to fuel oil users. The zone of economic viability for the subject plant encompasses sufficient potential COM conversion applications to justify the 20,000 BPD concept preparation plant. The most severe hurdles to near-term commercializaion are user acceptance and long-term commitment to COM.

28111 (CONF-810498—(Vol.1), pp 319-334) **Regional coal-oil mixture facility for the metropolitan New York region.** Lilley, W.; McLean, J. 1981. NTIS, PC A20/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

A regional coal-oil mixture (COM) facility has economic advantages over individual COM power plant facilities and can reduce some of the significant environmental impacts of coal conversion of oil-fired power plants. In the Metropolitan New York (MNY) region, there is a concentration of 16,000 MW of oil-fired generating capacity of which 9000 MW are being considered for coal conversion and 7000 MW are not. Therefore, there is a large potential market for a regional COM preparation facility. There are environmental advantages to the use of COM from the reduction of impacts on water quality, air quality, noise, land use, transportation, and social aesthetics. COM's also have economic advantages through reduction of capital requirements for unloading, storage, combustion, and coal cleaning facilities. A large regional facility will have further significant economic advantages over COM facilities at individual power plants. There is need for a detailed environmental, economic, and engineering study to evaluate the merits of a regional COM preparation facility as an alternative to development of facilities at individual power plants which are now burning oil.

28112 (CONF-810498—(Vol.1), pp 335-341) **Stabilization of coal-oil mixtures by chemical additives.** Rowell, R.L. (Univ. of Massachusetts, Amherst); Kosman, J.J.; Batra, S.K.; Tsai, T. 1981. NTIS, PC A20/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

The stabilization of coal-oil mixtures by various additives has been studied by sedimentation, subsidence, pycnometry, solvent extraction and microelectrophoresis. The experimental results from the several approaches are shown to be consistent with the concept that a stable COM is a loosely dispersed flocculated network with structural support and fluidity controlled by interparticle forces. The role of chemical additives in COM stabilization is to control the interparticle forces. Many bituminous coals exhibit a surface character that is generally nucleophilic. It is shown that a stabilizer with variable electrophilicity serves as a universal additive for COM prepared from such coal in No. 6 fuel oil.

28113 (CONF-810498—(Vol.1), pp 342-386) **Additives for fine COM.** Naka, A.; Ogura, Y.; Fukuda, T. 1981. NTIS, PC A20/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

This study shows that addition of 0.08% to 0.12% of ACOM to COM, followed by adequate mixing procedures, results in COM stabilization for periods lasting more than one month, making therefore possible practical use of COM without risk of sedimentation of the coal particles contained in the COM. The COM stabilization mechanism has been successfully clarified. Results of studies based on the said stabilization mechanism model allowed us to develop a simplified COM stability quality control method, which makes possible forecasting of COM stability within a short time. Processes for practical use of COM are progressing steadily in Japan, with tests on blast furnace combustion and tanker transportation of COM containing ACOM-201 and ACOM-202 presently under way.

28114 (CONF-810498—(Vol.1), pp 387-423) **Studies on the stabilization of COM.** Shimamura, Y.; Ukigai, T.; Igarashi, T. 1981. NTIS, PC A20/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

The KLN group has been participating in the coal-oil mixture (COM) project promoted by the Electric Power Development Co., Ltd. In the present paper the authors report on contributions made by the KLN group to the software aspect of COM, including stabilizing agents. Studies were carried out on lignite, sub-bituminous and bituminous coal, mainly of Australian origin, in addition to coals of a North American and South African origin, and on COM using these types of coal. As stabilizing agents suitable for COM, T-120, T-152 and T-191 were developed. These stabilizing agents make possible stabilization of all types of COM for periods of time lasting from one through two months by addition of small quantities of the order of 0.08 wt. %. As for the method for COM quality control, the procedures announced by the authors at the II International Symposium on COM were applied to various types of coal, the effectiveness being confirmed as a result.

28115 (CONF-810498—(Vol.1), pp 424-441) **Procedure and equipment to continously prepare a stabilized COM with an aromatic bituminous material.** Iwako, H.; Ando, S.; Hayashi, A.; Koishi, M.; Takebayashi, H. 1981. NTIS, PC A20/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

Stabilized COM is continuously prepared with pulverized coal, initially impregnated with an aromatic bituminous hydrocarbon, and subsequently mixed into an emulsified residual oil by utilizing the Weighing Auto Feeder and Flow Mixer system. Colloidal asphaltene impregnated on the coal surface dissolves partially into emulsified residual oil and colloidal asphaltene on water droplet as proved by D.D. Eley, et al., disperses in oil matrix resulting in the coal stabilized initially by colloidal asphaltene layer and by the secondary colloidal asphaltene matrix which is assumed to be elastic from G.D.M. Mackey measurement of compression of compression modulus on asphaltene film. The Weighing Auto Feeder continuously feeds pulverized coal at an accurate feed rate by compensating flucutation in bulk density of pulverized coal. The impregnating model of the Flow Jet Mixer continuously impregnates pulverized coal, and the kneading model simultaneously emulsifies the residual oil with water and mixes the impregnated coal in the emulsified oil. Examination of the impregnation with an aromatic bituminous hydrocarbon by the scanning electron microscopy shows a colloidal aggregate of bituminous component upon the coal surface and the discriminative boundary between coal and oil fading into a more homogeneous phase. Stability is examined by rod penetration rheometry. It is assumed that COM which follows pseudoplastic flow having a high non-Newtonian index of viscosity of 0.39 and a high yield point of 8000 dyne/cm^2 could realize a static stability lasting to five weeks at 60°C.

28116 (CONF-810498—(Vol.1), pp 442-456) **Comparative study of COM preparation technologies.** O'Neill, J.K.; Kinneberg, D.J.; Viola, M.A. 1981. NTIS, PC A20/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

Four representative COM preparation technologies were compared with regard to cost, product quality, and operating flexibility. The quality of a COM is significantly affected by both the choice of coal and oil, and by the choice of process. Available data suggest that the ultrafine grinding approach to COM manufacture can yield products with good stability over ranges of coals, oils, and handling conditions. Stabilization of a coarser COM by ultrasonic dispersion of water may be more sensitive to coal and oil properties, but, the dispersed water is likely to enhance COM combustion characteristics. Chemical stabilization methods are likely to be most sensitive to changes in coal and oil properties, but may be tailored to a wider range of coals. Capital and oprating costs for all four approaches have been estimated on a consistent basis. Plant construction costs are dominated by coal receiving, storage, and grinding facilities and by liquid storage tanks. Working capital requirements are nearly as large as the cost of the physical plant. Roughly 90% of operating costs are accounted for by raw materials. Assuming that similar proportions of coal and oil are used, the investment requirements and operating costs for all four approaches are nearly identical, and are significantly below the current price of residual fuel oil. The cost of a COM can be minimized by choosing coal properties and processing approach such that: 1) good COM quality results; when 2) a high coal/oil ratio is achieved; and 3) low coal costs are incurred.

28117 (CONF-810498—(Vol.2), pp 582-592) **COM storage tank design.** Kuroita, K. (Tsukishima Kikai Co., Ltd., Japan). 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

Various studies and tests of fine COM storage methods have been carried out at the pilot plant (Step II) constructed jointly by Japanese plant makers, chemical additive makers and Tsukishima Kikai, under the leadership of the Electric Power Development Co., Ltd. (EPDC). Following pilot plant (Step II) operations, a demonstration plant (Step III) was constructed. Tsukishima Kikai Co., Ltd. carried out the design, manufacturing and construction of this demonstration plant. The key point in COM storage is how to cope with variations in the concentration and temperature of the COM and deposition and sedimentation of coal particles in case of long term storage. As a means of coping with these problems, we propose to move high concentration COM accumulated in the storage tank bottom region to the tank body periphery using a rake rotating at low speed in the interior of the tank. The highly concentrated COM is discharged to the exterior and returned again through the top of the tank using a circulation system. To solve the problems mentioned, stored COM is circulated from the bottom to the surface of the stored mixture. The present paper describes the design of this storage system.

28118 (CONF-810498—(Vol.2), pp 593-614) **Storage engineering of fine COM.** Iwatsuki, K.; Sakuraya, T. 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

The establishment of a practical means of storing large quantities of COM is an essential factor for realizing practical utilization of this fuel. The Electric Power Development Corporation (EPDC) is directing a joint research project on fine COM. As a part of this project, a series of storage tests were conducted on COM produced in a pilot plant. Repeated storage for durations of approximately one month and pumping out has led to the establishment of a practical technique promising stable and reliable storage of COM. The most essential elements in practical storage of COM are the system for agitating the COM and effective operation of this system. The purpose of this agitation is to homogenize the temperature and coal concentration of the COM, and to refluidize sediment when pumping out. The most suitable system for agitation would differ according to the tank size and purpose of storage. Mechanical mixers currently utilized in heavy oil storage tanks have been found to pose problems when used for long-term storage of COM, and the present study was conducted to explore the possibilities offered by gas agitation. Based on the suggestion of EPDC, tests were conducted at the Nagoya Works of the Nippon Steel Corporation, using a 250 kl heavy oil tank modified for the purpose with the installation of several gas nozzles. The results indicate this system is capable of bringing the fluid to a uniform mixture in a short time. The study demonstrated the possibility of realizing large-scale COM storage with the effective combination of gas agitation with techniques of stable COM storage.

28119 (CONF-810498—(Vol.2), pp 623-639) **Characterization of the various types of COM: its implication for utilization and specification of formulations.** Adams-Viola, M.; Botsaris, G.D.; Filmyers, W.G. Jr.; Glazman, Y.M.; Neuman, D. (Tufts Univ., Medford, MA). 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

A COM characterization system is described which is based on differences in the way the coal particles interact with each other. Experimental evidence which verifies the existence of such differences in the state of aggregation of the coal particles is presented and correlated to the nature of the sedimentation of the coal in model oil. When the coal particles are well dispersed, the coarse particles settle and form a very compact sediment, while the colloidal fines may remain suspended. When the coal particles flocculate into loose aggregates (or flocs), a network of coal particles can form throughout the bulk of the liquid. The liquid is entrapped in the interstices of this network and phase separation is reduced. A network can also form when the particles interact more strongly and coagulate into compact aggregates (coagula). Finally, the implications of the specific properties of each COM to the various steps of the COM utilization process are discussed.

28120 (CONF-810498—(Vol.2), pp 764-769) **Improved coal-oil mixtures.** Young, D.W.; Cherry, D.G. 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

A new class of additives that form gels in hydrocarbon products that are powerful dispersants has been patented in Great Britain. Complete specification published November 26, 1975, describes the preparation of certain inorganic salts of dialkyl monohydrogen orthophosphates, and how to use the salts in very low concentrations to form novel gel properties in hydrocarbon liquids. When the hydrocarbon material is of proper composition, traces of the inorganic salts at the correct pH will gel the hydrocarbon material. These gels are now being used for a large number of industrial research uses such as paint removers, fire starters, perfume base sol-

vent systems, and free grit lapping compounds. These uses are yet exploratory. It has also been found that powdered coal can be added to these gel hydrocarbon systems with slight agitation. Many blends have been made that contain 30 to 50% by weight of powdered coal (70% to 95% through 200 mesh). These coal-oil mixtures are very easy to pump and no powdered coal separates from the system even after being held in an agitated or quiet state for two and one-half years in glass or metal containers. The chemistry of the coal-oil system is described, along with costs to formulate products. The chemical structure of the gel making product must be altered as the viscosity of the hydrocarbon base stock increases.

28121 **(DOE/ET/10259—T2) Development of a fast fluid-bed gasifier, Phase II-A. Task 1 - Subtask 1.3, engineering study of coal handling system.** (Hydrocarbon Research, Inc., Lawrenceville, NJ (USA)). Apr 1981. Contract AC21-76ET10259. 23p. (FE—2361-8-4/81). NTIS, PC A02/MF A01. Order Number DE81025321.

HRI conducted this performance study of the Vac-U-Max coal transfer system, along with a companion study of alternative systems, as part of Contract DE-AC-05-80-ET10259. The Vac-U-Max is a pneumatic conveying system which transfers pulverized coal, and was an important link in the coal handling system during Fast Fluid Bed gasifier operations. During these operations the Vac-U-Max system experienced several periods of erratic performance. Vac-U-Max performance data was not collected under carefully controlled test conditions in these earlier operations and, due to this paucity of information, we could not derive a satisfactory explanation for the erratic coal transfer periods. For this reason, we conducted the study described in this report to determine whether or not the problem was inherent to the Vac-U-Max system and, if so, to find alternative systems which could satisfactorily transfer pulverized coal during Fast Fluid Bed Gasifier operation. It was concluded that the Vac-U-Max pneumatic conveying system appears to be capable of meeting the design coal transfer rate of 2000 lbs per hour. Our examination of the test data indicated the following: elevating the pick up point from grade level to a 12-foot height does not substantially improve material transfer rates; coal moisture content ranging from 2 to 8 W % did not substantially affect transfer rates during any part of the test period; and clean filters and adequate maintenance of the equipment, together with a sufficient flow of diluent nitrogen, appear to be the most important factors affecting performance of the unit. Since the Vac-U-Max operated satisfactorily during the tests we did not evaluate alternative conveying equipment beyond the preliminary steps described.

28122 **(DOE/ET/13032—1) Coal pump development. Phase III. Final report, October 1979-June 1980.** Kushida, R.; Sankur, V.D.; Gerbracht, F.G.; Mahajan, V. (Jet Propulsion Lab., Pasadena, CA (USA)). Jul 1980. Contract AI21-77ET-13032. 127p. (JPL-PUB—81-13). NTIS, PC A07/MF A01. Order Number DE81026221.

This is the final report on the Coal Pump Development task undertaken by the Jet Propulsion Laboratory for the Department of Energy. The report summarizes the previously documented Phases I and II efforts and continues the narrative description of the Phase III effort. The objectives of the task have been to: (1) establish a base of engineering experiences in the continuous extrusion of coal in the plastic state using modified thermoplastic extruders; and (2) assess the feasibility of developing large commercially applicable coal feeding systems based on this approach. Plastic state coal pumping of 12 different bituminous coals has been demonstrated on thermoplastic extruders of five different designs. The twin corotating continuous screw extruder has been found to be the best prototype for a large coal pump of commercial coal feeding size. Studies of application to a high pressure hydrogasification coal process show the advantage of using the coal pump over other feed methods. New data on the plastic state viscosity of coal, sliding friction of coal, and reactivity of extruded coal is reported. In the Phase III studies, techniques for achieving continuous coal sprays were studied. Coaxial injection with gas and pressure atomization were studied. Coal particles, upon cooling, were found to be porous and fragile. Reactivity tests on the extruded coal showed overall conversion to gases and liquids unchanged from that of the raw coal. The potentials for applications of the coal pump to eight coal conversion processes were examined.

28123 **(DOE/ET/13342—T1) Coal hydraulic transport at Bruceton. Final progress report.** Faddick, R.R. (Colorado School of Mines, Golden (USA)). 1981. Contract AC22-76ET13342. 12p. NTIS, PC A02/MF A01. Order Number DE81023665.

The DOE facility at Bruceton was visited and the following areas discussed: pipe vibrations, coal slurry flow in 6-in. dia pipe, pump operation, sample buggy, instrumentation, pressure calibration, and dewatering. Wear spools and their operation are discussed at some length. (DLC)

28124 **(DOE/EV/04427—T4) Evaluation of the effect of coal cleaning on fugitive elements. Final report. Phase II. Part I. Effect of cleaning.** Ford, C.T.; Price, A.A. (Bituminous Coal Research, Inc., Monroeville, PA (USA)). Sep 1980. Contract AC22-77EV04427. 277p. (COO—4427-38; BCR-L—1082). NTIS, PC A13/MF A01. Order Number DE81027148.

Twenty run-of-mine coals were subjected to conventional cleaning processes as well as to more extensive, non-conventional processes to evaluate the effect of such cleaning on fugitive elements - those elements which might be released to the surroundings and cause environmental problems. Based on the results, significant reductions were obtained in many of the trace elements reported to be pollutants when released during coal utilization. The cleaning was particularly effective in the removal of the trace elements arsenic, cadmium, chromium, cobalt, copper, fluorine, lead, manganese, vanadium, and zinc, and of the major elements silicon, aluminum, iron, calcium, magnesium, titanium, sodium, potassium, and phosphorus. The response of trace elements to cleaning was as variable as the response of sulfur, ash, and Btu content, which are customarily evaluated during conventional cleaning. Some similarities were found generally among those coals from similar geographic regions. Ineffective removal of most mineral constituents from the Western coals could be attributed to the low initial concentrations of impurities in these coals. Each step in the cleaning process was evaluated separately, and more effective trace-element removals were obtained from cleaning the coarser sizes. This study also provided an opportunity to demonstrate BCR's analytical capabilities as effective tools for solving potential coal-industry problems in this area. The analytical methods used in this study have been incorporated into a comprehensive and usable manual which can be found under separate cover as Part II of this final report. A state-of-the-art report on the effect of coal mining, preparation, transportation, and utilization on fugitive elements can also be found under separate cover as Part III of this final report.

28125 **(DOE/MC/14266—T6) Program plan manual for coal materials handling: classifier evaluation.** Rogers, R.S.C.; Hukki, A.M.; Luckie, P.T. (Kennedy Van Saun Corp., Danville, PA (USA); Pennsylvania State Univ., University Park (USA)). 1979. Contract AC21-80MC14266. 57p. NTIS, PC A04/MF A01. Order Number DE81026209.

Based on studies conducted by Hukki, there is evidence to show that the Hukki classifier might well be an excellent classifier for dry coal grinding applications. In fact, the classifier is presently being used in an industrial coal grinding circuit in Finland. In light of these recent developments, the present program was initiated, the objective being to evaluate the Hukki centrifugal classifier as a classifier for fine coal. Under this program, the classifier will first be evaluated in the stand alone (open circuit) condition using an air-swept ball mill to prepare the classifier feed. This will be done to study the effect of feed rate, feed size consist, fluid/solid ratio and adjustable settings of the classifier on overall classifier performance. Then, comparative, closed circuit testing of the Hukki, twin cone and vari-mesh classifiers will be conducted utilizing the air-swept ball mill as the comminutor. The test work will be evaluated based on size selectivity and the reduction of specific grinding energy.

28126 **(DOE/PC/30144—T4) Expansion of coal preparation plant simulator. Progress report, April 1-June 30, 1981.** (Pittsburgh Univ., PA (USA). Dept. of Industrial Engineering). 1981. Contract AC22-80PC30144. 3p. NTIS, PC A02/MF A01. Order Number DE81027111.

The following items have been completed, or partially completed. The module to predict the moisture content of each coal

flow-stream has been completed. This module determines moisture content as a function of size and specific gravity, and is callable from routines within the program. The routine does, however, make use of a few key physical parameters whose values are not accurately known. Thus, the user should exercise some discretion in interpreting the results of these calculations. Substantial progress has been made on the dewatering module. Preliminary work has been completed, on a centrifuge model, and work is now in progress on a vacuum filter model. Some additional refinements will be incorpoated. Upon completion of these models we plan to consider static thickeners and cyclone thickeners. Thermal dryers will also be considered if time permits. A prototype froth flotation module utilizes a model based upon a reaction-rate concept. The flotation rate of each substance is assumed to be proportional to the concentration of that substance in the pulp. An overall plant summary being added to the very end of the output will contain information on flowrate, percent ash, percent sulfur, moisture Btu content and lbs. SO_2/million Btu for the feed stream and the combined clean coal, middlings and refuse streams leaving the plant. We also plan to add some overall economic parameters indicating the cost of cleaning a ton of feed, a ton of clean coal and a ton of clean coal plus middlings. The latter calculations will be based upon overall cost data entered as input data.

28127 **(DOE/PC/30235—T1) Selective grinding of coal for efficient pyrite removal. Semiannual progress report for period ending June 30, 1981.** Hall, M.R. (Southern Illinois Univ., Carbondale (USA)). 1981. Contract FG22-80PC30235. 24p. NTIS, PC A02/MF A01. Order Number DE81027877.

Sample collection was slowed somewhat by the coal strike, but fourteen samples are now on hand from the following states: Alabama, Illinois, Iowa, Kentucky, Ohio, Missouri, Pennsylvania and West Virginia. Work has begun on ten of these samples which have significant amounts of pyritic sulfur. Grinding and beneficiation tests on the original set of five samples is nearly complete. This work has produced some changes in the research plan, notably that coal swelling fluids are now used to pre-soak the coal before grinding and dry grinding has been eliminated as too inefficient to be worthwhile. Analysis of the data for pyrite distributions is now being done by computer. This work reveals that most of the data on the number per unit volume of pyrite particles of a given size fit a log-normal distribution. Some exceptions are noted which may be artifactual or due to different conditions of deposition for the pyrite over different time periods. Beneficiation results have not been very good as yet, but in one case about half of the sulfur was removed. Experimental procedures are being reviewed in order to improve these results.

0140 Combustion

REFER ALSO TO CITATION(S) 28046, 28056, 28085, 28105, 28106, 28107, 28108, 28109, 28357, 28364, 28587, 28588, 28591, 28606, 28838, 28939, 28949

28128 (CONF-810498—(Vol.1), pp 177-181) **Liquicoal demonstration project.** Poetschke, L.E. 1981. NTIS, PC A20/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

The objectives of this test series were to: 1. evaluate spherical agglomeration as a preparative step in manufacturing coal-oil-water slurry (COW) mixes; 2. evaluate COW pumping, handling and stability; and 3. evaluate COW combustion characteristics including thermal efficiency, emissions, and slagging and fouling. The 12 tons of fuel used in the test were produced in a bench plant located at the Centre for Energy Studies.

28129 (CONF-810498—(Vol.1), pp 182-195) **Development and burning of coal/water slurries.** Scheffee, R.S.; Rossmeissl, N.P.; Boyd, T.J.; Henderson, C.B.; McHale, E.T. (Atlantic Research Corp., Alexandria, VA). 1981. NTIS, PC A20/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

This report summarizes results of a continuing program to develop and evaluate highly-loaded coal-water slurry fuels. The objective of the work is to (1) evaluate the effect of additives and of coals of various ash contents, volatiles content, the solids loading and particle size on slurry rheology, stability and combustion, and (2) set up a small slurry processing plant to produce slurry at the rate of 1 bbl/hr. The present work is being carried out with a Kentucky bituminous, which is a medium-ash (6.37% dry basis), high-volatile (35.57%) coal. A continuous processing plant of 1 bbl/hr capacity has been set up and is operational. In the present configuration, the coal can be dry milled by hammermilling or dry or wet milled by ballmilling. Wet ball milling studies indicate that production rate of coal pulverized to a given particle size is invariant with mill base composition. Theoretical size distribution curves are shown to be a useful guide for formulating to high solids loadings. A preliminary economic analysis is also presented, and recent results from combustion tests are presented to update earlier reports given at the 2nd COM Symposium.

28130 (CONF-810498—(Vol.1), pp 196-209) **Forging with coal-oil mixtures: metallurgical and environmental effects.** Bjerklie, J.W.; Green, C.P.; Penty, R.A.; Young, S.B. (Hague International, South Portland, ME). 1981. NTIS, PC A20/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

COM consisting of 50 wt % powdered bituminous coal (-325 mesh) and 50 wt % number 6 fuel oil was burned in a forge furnace to demonstrate its use as a fuel for the forging industry. A high performance slot forge furnace was chosen as a demonstration bed. This furnace incorporated a high temperature ceramic recuperator, improved insulation and slot closures, and automatic excess air trim controls. Modifications to its fuel delivery system, burners, and controls were made to adapt the furance to COM firing. The COM was burned in a single burner at rates of 60 ppH to 240 ppH (27.2kg/hr to 108.9 kg/hr). Forgings were made of AISI 1035 and 8620 steel with COM as the heat source. Forgings were made with number 2 fuel oil as a control. Samples of all four groups of forgings were subjected to chemical analysis; scale analysis; hardness tests; tensile strength tests; elongation, grain flow, and reduction of area examinations; surface decarburization examination; Charpy impact tests; and scanning electron microscopy. It was established that sound forgings can be made using COM as fuel, and that use of COM in a fully improved slot forge furnace could cut oil consumption in forging by 87% compared to the use of oil in a conventional furnace. The effects of COM on ceramic and metallic materials of furnace construction were investigated. Emissions data collected by independent agencies show that COM can be used as a fuel for forging furnaces in many states without additional stack controls. Reductions in sulfurous gas emissions were demonstrated by means of addition of chemical sorbents to the COM slurry. The sulfur/sorbent stoichiometric ratio was kept constant for each demonstration run, and was varied between 0.74 and 5.32 for individual tests. The sulfurous gases were converted to particulate sulfates or sulfites which can be collected downstream in a baghous or electrostatic precipitator in an industrial installation.

28131 (CONF-810498—(Vol.1), pp 227-241) **Control of flow rate distribution of COM.** Hisamitsu, N.; Miyazaki, T.; Shoji, Y.; Fukuda, T. (Sumitomo Metal Industries, Ltd., Amagasaki, Japan). 1981. NTIS, PC A20/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

The control of flow rate distribution of COM to blast furnace tuyeres was studied. The experimental loop line provided with six branches and a microcomputer I/O system was constructed. The control program gives suitable valve openings for the predetermined flow rate values. It consists of two steps; the first step is the rough calculation of valve openings by the use of a flow rate simulation in the branching pipeline system and the second is the adjustment by the use of flow characteristics of the control valves. It is possible to control the flow rate in each branch within +- 3% of the predetermined value.

28132 (CONF-810498—(Vol.1), pp 242-261) **Rheology and combustion of COM preliminary results of activity.** Girardi, E.; Passarini, N. (Assoreni, Italy). 1981. NTIS, PC A20/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

A research program on laboratory characterization and bench scale preparation and combustion of coal-oil mixtures is in progress. The main purpose is the determination of the physicochemical characteristics of the mixtures and in particular their rheology and stability. Mixtures containing coal up to 50% wt. have been investigated in the temperature range 40°C to 140°C. Mixture of coals of different quality and No. 6 fuel oils typical of the Italian market have been tested. Rheological data have been fitted with different models. At high temperatures and at low coal concentrations, the mixtures show Newtonian behavior, whilst with decreasing temperature and increasing coal concentration the data are best fitted by a pseudoplastic model. A bench scale plant for preparation of the mixtures, 30 kg/h capacity, has been operating for a few months. The plant comprises essentially a ball mill, a mixing tank for coal and oil, a recirculation pump, and a feed pump to a furnace for combustion testing. No additive has been used up-to-date for the preparation of the mixtures. The combustion tests are underway. Standard furnace and burner are being used because the approach in this study is to check first what are the minimal changes to be brought to the existing equipments for conversion from fuel oil to COM.

28133 **(CONF-810498—(Vol.2)) 3rd international symposium on coal-oil mixture combustion.** (Department of Energy, Pittsburgh, PA (USA). Pittsburgh Energy Technology Center). 1981. 687p. NTIS, PC A99/MF A01. Order Number DE81027083.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

The proceedings of this conference has been published in 2 volumes. Volume 2 contains papers presented in the following subject areas: equipment; rheology; commercialization and economics; and combustion and emissions. Separate abstracts have been prepared for each article for inclusion in the Energy Data Base. (DMC)

28134 (CONF-810498—(Vol.2), pp 457-479) **Design considerations and operating experience of the Sanford COM test facility.** Kasprik, A.J. (Florida Power and Light Co., Miami); Causilla, H.; Kartzke, P. 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

A 400 MW oil-fired boiler has been fitted with new burner guns and accessories to burn coal/oil mixture (COM) for a 120 full-power burn-day demonstration. Coal unloading and storage, and COM preparation and storage facilities have been installed adjacent to the power house. Modifications to the steam generator and firing systems have been made. Burn tests through 50 percent (by weight) have been completed, and optimization and long-term test programs are under way. This paper describes the reasons for the demonstration, the project schedule, and the test facility itself. Discussions are also included of the rationale for equipment and process selection, the test program, and some of the operating experience that should be considered in the design of future permanent facilities.

28135 (CONF-810498—(Vol.2), pp 541-581) **Handling and combustion of stable coal/fuel oil dispersions.** Wall, D.R. (BP Research Centre, Sunbury-on-Thames, England). 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

700 tonnes of stable coal/fuel oil dispersion (nominally 40 per cent weight coal in heavy fuel oil) have been handled in a system designed for heavy fuel oil. 500 tonnes of this material has been held in a fuel oil storage tank for almost a year. Laboratory storage experiments utilising 200 litre drums and fuel oil storage tanks are covered and the results obtained interpreted in relation to the BP stability sedimentation test measurements. A pumping rig designed to evaluate the performance of pumps, valves, meters, on-line monitoring equipment has been built. In addition, wear and erosion studies are being undertaken. The combustion of stable coal/fuel oil dispersions has been evaluated in the following equipment: marine water tube boiler; utility boiler; cement kiln; fluidised bed combustor; hot walled furnace; and diesel engine. Details on each of the experiments undertaken are given.

28136 (CONF-810498—(Vol.2), pp 825-840) **Commercial COM operation, an up-date.** Hawkins, G.T. 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

At the Second International Symposium, CoaLiquid, Inc. (CLI) briefed attendees as to the construction and operation of a commercial scale, central preparation plant for coal-oil-mixtures. That report discussed in detail the problems associated with the design, construction and operation of such a plant, including the environmental considerations, permitting requirements and a marketing strategy. The facility, owned by CLI, is located in Shelbyville, Kentucky, and is fully operational. Since that report, CLI has continued and expanded its efforts. Large scale production and combustion demonstrations have been successfully conducted in many locations across the United States. To facilitate the marketing effort, CLI has constructed a special trailer containing all equipment needed for a temporary COM retrofit. The author shares quantitative test results derived from these demonstrations. Specific demonstrations to be reported upon include the following types of combustion units: kilns and calciners, industrial boilers, blast furnaces and driers. Details on combustion efficiencies and stack emissions will be reviewed. Also to be outlined are suggestions on the storage, handling and transporting of COM in substantial quantities.

28137 (CONF-810498—(Vol.2), pp 966-989) **Theoretical boiler performance when firing BP coal-oil dispersions.** Gadbury, P. (BP Coal-Oil Fuels, London, England). 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

BP Coal-Oil Fuels will produce some 100,000 tonnes/year of the BP high stability coal-oil dispersion when the UK production plant at West Thurrock is commissioned in the fourth quarter of 1981. Meanwhile BP has commissioned a series of combustion rig and practical boiler trials in the UK and Europe, some of which have been completed in the early part of 1981 using coal-oil fuel made in April 1980 and held in conventional storage tanks to demonstrate the long term stability of the BP product. When West Thurrock is on-stream, long term user trials will be undertaken on conventional boiler plant and in anticipation of these trials BP commissioned a theoretical study on three existing modern oil design boilers to compare oil and coal-oil firing boiler performance. The paper presents the salient features of the boiler performance predictions which indicate that the furnace exit temperature and flue gas velocity are the more significant factors in regard to potential derating. Furnace temperature curves are presented with super-imposed coal ash fusion levels together with curves of the flue gas velocities at the position of greatest speed through each unit. General comment is made on the avoidance of untoward derating and the performance of draught plant. The presentation is based on a theoretical performance analysis by an experienced and recognised major boiler manufacturer and is intended as a forerunner for extended practical trials.

28138 (CONF-810498—(Vol.2), pp 990-1016) **Effect of coal particle size consist on the performance of a COM-fired boiler.** Pan, Y.S.; Wildman, D.J.; Bellas, G.T.; Joubert, J.I. (Dept. of Energy, Pittsburgh, PA). 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

COM combustion tests to determine the effect of coal particle size consist on boiler performance have been conducted at the PETC COM Combustion Test Facility. The mixtures contained 40 percent Pittsburgh seam coal pulverized to consists ranging from 92 percent minus 325 mesh to 60 percent minus 200 mesh. At full load, average values of carbon conversion efficiency ranged from 99.3 percent (fine coal) to 97.5 percent (coarse coal); boiler efficiencies ranged from 82.0 percent to 81.3 percent for the fine and coarse coal, respectively. The rate of deposition of ash in the boiler was found to increase with increasing fineness of the coal. In flue gas desulfurization tests conducted concurrently with the particle size tests, up to 90 percent SO_2 removal was obtained via dry injection of sodium bicarbonate into the boiler flue gas duct upstream of the baghouse.

28139 (CONF-810498—(Vol.2), pp 1017-1033) **Performance tests of ultra-fine grind coal-oil mixtures in a 150 HP boiler.** Rose, M.J.; Butcher, T.A. (Brookhaven National Lab., Upton, NY). 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

Lab tests on coal slurries have indicated that the coal particles inside of a drop will agglomerate during combustion. This would produce larger ash particles than if the coal were dry, defeating one of the purposes of the finer particle size. The tests reported here have been performed at Brookhaven National Laboratory with a 150 H.P., 4-pass, fire-tube boiler firing a coal-oil mixture with coal mean size less than 2 microns. The degree of carbon burnup, and the fly ash/bottom ash split, have been measured and related to the agglomeration discussion above. The results indicate that agglomeration does occur to some degree and that the use of micron size coal does not eliminate the ash deposition problem with coal slurries. The application of micronized coal, in coal-oil fuel blends, does have important advantages, when compared to other reported tests utilizing coarser coal. It permitted the performance tests to be conducted with essentially no modifications to the OEM designed fuel oil handling and burning sub-systems. Although the program was of short duration the baseline results have shown that no technical or operational problems were encountered with such critical components as fuel heater, burner atomizer nozzle assembly, fuel control valve and regulator, storage tanks, etc. Test results also indicated that the combustion efficiency, of micronized coal-oil blends (up to 30% coal by weight), were comparable with that of the originally specified boiler fuel, commercial ASTM grade No. 4 fuel oil.

28140 (CONF-810498—(Vol.2), pp 1034-1054) **Experimental study of COM combustion process in the tunnel furnace.** Cao, Y.Q.; Kang, C.F.; Jang, S.H. 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

The construction features of the tunnel furnace for experimental study of COM combustion, the types and characteristics of COM burners are briefly introduced. Two different types of atomizing nozzles have been used for investigation of coal-oil slurry injection in the tunnel furnace. Under given operation conditions the furnace could run with good stability for a long duration when burning COM with coal concentration as high as 40 to 50%. The combustion efficiency approached that of the furnace when burning heavy oil. The variation of the gas temperature, the concentration of various gas components and the rate of mass flow of COM under burning condition at different cross-sections along the axis of the furnace have been measured and the explanation of which has also been given. From the tendency of the analysis of components of particulate solids sampling from the COM flame at various cross-sections along the axial distance of the furnace, the variation of their different components and the rate of heat release have been learned. It is clear that the combustion of oil droplets and ignition as well as combustion of coal particles have overlapped for the most portion of the time. According to microscopic examination of the samples, it is found that the combustion of COM in the furnace has been carried out in the form of cenospheres. After heating up, the cenospheres grow up with exit openings of different sizes. The heat flux and the emissivity of COM flame under the different volumetric burning intensity along the tunnel furnace have also been determined. It is of no doubt that the combustion property of COM in the furnace is quite different from that of heavy oil droplets or that of coal particles.

28141 (CONF-810498—(Vol.2), pp 1081-1100) **Handling, combustion and emissions from coal-oil dispersions when fired through an LPA burner.** Alabaf, J.S.; Patterson, M.C.; Moles, F.D. (Univ. of Surrey, Guildford, England). 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

As crude oil supplies decline, and coal replaces oil as the major fossil fuel source, short term alternative energy forms, such as coal-oil mixtures, can spread over several years the large capital investment involved in the conversion of major utilities from oil to coal firing. In May 1977 a research programme was initiated at the University of Surrey to compare the combustion of fuel oil and coal-oil dispersion under similar non-optimised combustion conditions. Initial work involved the conversion of the Chemical Engineering Department's pilot scale combustion rig to handle coal-oil dispersions, and burn them using a Stordy-Hauck low pressure air-atomised burner. The combustion performance of a 35% dispersion of anthracitic, medium and high volatile coals in 950 second fuel oil has been investigated, and compared to the constituent fuel oil over a range of excess air values. Burner erosion has been negligible. Emissions of sulphur oxides are reduced, nitrogen oxides are increased and particulates levels are higher from coal-oil dispersions when compared to 950 second fuel oil. Coal rank was very significant. Flame burn-out time is increased by coal.

28142 (CONF-810498—(Vol.2), pp 1123-1133) **Preliminary tests on coal-oil mixture and its mechanism studies.** Shang, S.D. (Shanghai Ship Research Inst., People's Republic of China); Fong, T.Y. 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

Coal-Oil-Mixtures (COM) and water-oil-coal mixtures (WOC) preparation and combustion testing has been performed and the results are presented in this paper. COM or WOC fuel produced physical mixing of coal and oil or coal water, oil, and lime. There is no chemical reaction taking place; however, each has its own special characteristics. COM or WOC fuel is a slurry liquid fuel. Using propellers, liquid whistles, piezo-electric transducers, ultrasonic burner combined techniques, both COM and WOC fuel can be successfully produced. To put COM or WOC fuel to practical use, there is still much work left to investigate, namely: the method of stabilization, the theory of fluid flow (including piping design information, i.e., fluid velocity, pressure drop, and critical speed or empirical formula), the theory of combustion, measuring instruments, etc.

28143 **(DOE/ET/10746—T1) Studies for the stabilization of coal-oil mixtures. Final report, August 1978-May 1981.** Botsaris, G.D.; Glazman, Y.M.; Adams-Viola, M. (Tufts Univ., Medford, MA (USA). Dept. of Chemical Engineering). 1981. Contract AC22-78ET10746. 436p. NTIS, PC A19/MF A01.

A fundamental understanding of the stabilization of coal-oil mixtures (COM) was developed. Aggregation of the coal particles was determined to control both the sedimentation and rheological properties of the COM. Sedimentation stability of COM prepared with coal, 80% $<$ 200 mesh, is achieved by particle aggregation, which leads to the formation of a network of particles throughout the oil. The wettability of coal powders was evaluated by the Pickering emulsion test and a spherical agglomeration test to assess its effect on the stability of various COM formulations. Sedimentation stability of hydrophilic coal-oil-water mixtures (COWM) involves the formation of water bridges between the coal particles, while less stabilization of oleophilic COWM is achieved by the formation of an emulsion. Anionic SAA were least sensitive to the coal type and enhanced the aggregation stability of the suspension. The effect of cationic SAA, nonionic SAA and polymer additives depended upon the specific chemical structure of the SAA, the water content of the COM and the type of coal. The sedimentation stability of ultrafine COM was not directly due to the fineness of the powder but due to the formation of a network of flocculated particles.

28144 **(DOE/ET/13152—T1) Measuring and modeling solids movement in a large, cold fluidized-bed test facility. Sixth quarterly report, January 1, 1981-March 31, 1981.** Fitzgerald, T.J.; Mrazek, R.V.; Crane, S.D. (Oregon State Univ., Corvallis (USA). Dept. of Chemical Engineering). Mar 1981. Contract AC01-79ET13152. 18p. NTIS, PC A02/MF A01.

An instrument is being developed to measure the flow of magnetic solid particles in a fluidized bed. Design and calibration of the instrument are discussed. (LTN)

28145 **(DOE/ET/15457—23) Long-term materials test program. Quarterly report, January-March 1981.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). 1981. Contract AC21-79ET15457. 38p. NTIS, PC A03/MF A01. Order Number DE81027879.

Several successful half day exploratory light-offs on coal have been accomplished at atmospheric pressure at the full bed temperature of 1800°F. The tests have taken place in the bypass mode. Installation of the high and low velocity test sections is now in progress. Minor problems have been noted during operation and are being corrected with minimum delay. A typical example is the rotary valve from Willomont-Flemming which jams frequently. The gas analysis, dust and alkali sampling systems have been installed during the initial start-up Qualification Testing. These systems have been checked out and are operational. The delivery of the Low Velocity Test Section has been delayed by about one month. To date approximately 75 hours of Test IV on the Small Burner Rig has been completed. It has been generally observed that flyash is dissolved from the test specimen surfaces in about 3 to 4 hours, in the presence of alkali contaminants. The initial plan to run a 1000-hour continuous materials screening test on the Improved Erosion/Corrosion Simulator has been replaced by conducting incremental 250-hour tests under varying conditions. 23 figures, 4 tables.

28146 **(DOE/ET/17093—T2) Testing and verification of granular bed filters for the removal of particulate and alkalies. Second quarterly project report, January 1-March 31, 1981.** (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). 20 Apr 1981. Contract AC21-80ET17093. 164p. NTIS, PC A08/MF A01. Order Number DE81026357.

The Westinghouse Electric Corporation with Ducon, Inc. and Burns and Roe, Inc. are conducting a test and evaluation program of a Granular Bed Filter (GBF) for gas cleaning applications in pressurized-fluidized bed combustion processes. This work is funded by DOE PRDA for Exploratory Research, Development, Testing and Evaluation of Systems or Devices for Hot Gas Clean-up. This report describes the final design of the pilot scale test unit, initial test results from the bench scale alkali gettering work and preliminary results from the GBF system analysis for both particulate and alkali control.

28147 **(DOE/METC/SP—108) Atmospheric fluidized-bed projects technology overview.** (Department of Energy, Morgantown, WV (USA). Morgantown Energy Technology Center). Feb 1981. 66p. NTIS, PC A04/MF A01. Order Number DE81027143.

This Atmospheric Fluidized-Bed Combustion (AFBC) Technology Overview describes the accomplishments of the DOE AFBC program during fiscal year 1980. The report addresses the methodology by which DOE-funded projects achieved the goals and objectives of this program. It reviews the status of the technology, identifies areas where further development or research is required, and identifies projects where this work is currently being addressed or will be addressed. The primary goal of the DOE AFBC program is to develop a comprehensive data base in fluidized-bed combustion that will provide industry, both manufacturers and users, with information to enable them to decrease their use of oil by the substitution of fuels readily available within the US. The objectives of the program include demonstrating process reliability with numerous fuels, developing an operating/maintenance cost data base, and developing the technology in those areas where demonstrations show further work is required. In addition, tests are sponsored in areas where further data is required to verify or expand the existing technology data base. Concepts offering significant improvements to the FBC technology are explored as part of this program. Current program issues include feed systems, heat transfer, recycle, air-distributor grid design, ignition characteristics, output control, particulate emissions, reliability, and fuel flexibility.

28148 **(DOE/PC/30290—T3) Preignition volatile yield as related to coal characteristics. Quarterly report, April 1981-June 1981.** (Avco-Everett Research Lab., Inc., Everett, MA (USA)). Jul 1981. Contract AC22-80PC30290. 16p. NTIS, PC A02/MF A01. Order Number DE81027584.

The objectives of this work is to determine the total release of volatile material from a variety of coals under high heating rates and high temperature and to study the effects of enhanced volatile matter release on the design of pulverized coal combustion systems. Twelve coals from the list of selected coals have been received and are currently being characterized regarding their proximate and ultimate analysis, reflectance, surface area, and petrographic composition. Devolatilization experiments have been completed at two temperature levels for nine of the twelve coals. In addition the effect of particle size on preignition volatile yield has been investigated for Illinois No. 6 coal. The relation between preignition volatile yield and such coal characteristics as: (1) carbon content; (2) hydrogen to carbon ratio; (3) proximate volatile matter; (4) reflectance; (5) surface area; and (6) various functions of the petrographic composition have been studied. From the coals tested thus far the most direct relation is between the volatile yield and carbon content. The AERL coal combustion model has been modified to allow exploration of the effect of preignition volatile yeilds on flame stability in a swirl burner.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 28044, 28045, 28047, 28054, 28814, 28817

28149 (CONF-810498—(Vol.2), pp 770-824) **Coal-oil mixtures as utility boiler fuels.** Azarnoosh, A.; Manfred, R.K.; Siemssen, J.O. 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

A study has been conducted to: develop guidelines for the electric utility industry to assess the technical and economic applicability of coal-oil mixtures to existing fossil fuel plants; and assess the cost of preparation and supply of suitable coal-oil mixtures for use by electric utility entities. A survey of existing utility boilers was made to define a group of units which were designed to fire oil, had significant remaining service and represented a broad cross-section of the industry. Studies done using these boilers as models will lead to a detailed understanding of what can be expected in converting to a coal-oil mixture (COM) fuel. Results of this study will be summarized in a handbook format which will be issued at the completion of the project. In addition, the logistics of a COM industry are being analyzed. A detailed marketing study has identified market clusters for potential COM utilization in the Northeast, Middle Atlantic states, Florida, Gulf Coast and Southern California. A large centrally located COM manufacturing plant was favored due to economics of scale. Based on a transportation cost analysis, Baltimore was chosen as the site for the central facility because of its proximity to coal reserves and central market position. Plant size was set at 90,000 B/D of COM product based on the market, transportation factors and the scale of processing equipment within current technology. Several alternate manufacturing methods were considered for the central facility. Dry grinding, followed by mixing with No. 6 oil was chosen for a detailed economic evaluation because this represents the method furthest developed commercially.

28150 (CONF-810498—(Vol.2), pp 841-860) **Technical and economical implications of COM pricing and contracting.** Albert, M.E.; Bessette, R.D. (Island Creek Coal Sales Co., Lexington, KY). 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

There has been much discussion regarding the pricing structures which surround COM from one side or another, i.e., potential customer savings - potential producer profits; production plant payback - conversion cost payback - technical needs; all within the aura of an unstable oil supply and cost environment. The evaluation of COM pricing components with consideration of potential benefits in conjunction with potential risks is made difficult by a lack of hard facts or a long-term experience. This paper will: (1) provide a basis for an evaluation of COM as a potential alternate fuel, (2) provide a method by which a COM can be discussed with relation to the cost-benefit-risk (CBR) approach after a gross margin determination, (3) define a method for calculating gross margin for alternative COM use requirements, (4) provide a subjective method for determination of CBR effects relative to fuel selection and technology utilization. The general method of accomplishing the above will be to define gross margin. Each aspect of the COM cost component will be discussed within a CBR structure considering fuel feedstock variation, supply applicability to equipment, and production technology implication. Following the definition and calcula-

tion of gross margin, the sharing of the gross margin will be discussed from an investment payback/oil market risk acceptance point of view. A general COM contract philosophy will be discussed. After careful discussion of the above, it will be noted that the price for COM must be related to the oil price and that COM price will be dependent on the mutual requirements of both user and producer. These requirements will be set out so user-producer needs can be arrived at without prejudice over the life of the agreement.

28151 (CONF-810498—(Vol.2), pp 861-887) **Conversion of oil-fired industrial boilers to coal-liquid mixtures.** Blake, J.C.; Foo, O.K.; Jamgochian, E.M. 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

A compilation of the industrial boiler market, based on three previous surveys, was made to assess the potential of oil-to-coal conversion of oil-fired boilers. The large oil-fired boilers are concentrated in the Eastern and Mid-Western states where reduction of imported oil consumption is a major concern. Over half of the large oil-fired boilers are less than 20 years old making oil-to-coal conversion economically feasible. If a quarter of these large oil-fired boilers are converted either to coal-oil mixtures or coal-water mixtures, the estimated oil savings will be 25 x 10^3 bbls/day or 85 x 10^3 bbls/day respectively. The economic feasibility of converting oil-fired industrial boilers to coal-oil mixtures or coal-water mixtures depends on several closely interrelated factors: capital costs for the conversion, incremental operating and maintenance costs of the converted plant, fuel costs, transportation costs, capacity factor, coal loading, and the thermal efficiency of the boiler firing coal-liquid mixtures. A computerized financial model which includes inflation, fuel escalations, debt/equity rates, and depreciation was used to evaluate the conversion profitability of four different sizes of boilers. The flue gas heat losses for various coal-liquid mixtures are calculated but are not economically significant relative to oil. The slightly lower thermal efficiency for coal-water reduces the cost savings, but the reduction is small compared to the large overall savings achieved by switching from oil to coal-water mixture. (CWM).

28152 **(LA—8906-MS) National coal-market conditions for the year 2000: regional-issue identification and analysis, high scenario.** Wolak, F. (Los Alamos National Lab., NM (USA)). Jul 1981. Contract W-7405-ENG-36. 18p. NTIS, PC A02/MF A01. Order Number DE81026425.

Several coal market data inputs were necessary to operate the model used for the solid-waste impacts of coal-fired electricity production portion of the Regional Issue Identification and Analysis program. The Los Alamos National Laboratory Economics Group ROCKY3 model generated minemouth prices and quantities produced for each coal type from each coal supply region and the delivered price and quantity to each coal consumption region of each coal type from all of the coal supply regions.

0160 Health And Safety

REFER ALSO TO CITATION(S) 29354

28153 **(CONF-8007107—2) Energy analysis of human ecosystems in an Appalachian coal county.** Watson, A.P. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 31p. NTIS, PC A03/MF A01. Order Number DE81025177.

From International symposium on the human side of energy; Laramie, WY, USA (7 Jul 1980).

Preliminary results from a energy analysis of the coal fuel cycle in an Appalachian coal county has provided systematic assessment of hidden energy subsidies in extraction, transport, processing, and combustion. Current results indicate a major loss due to depletion of the coal resource base by use of inefficient mining techniqus. Although of smaller magnitude, reductions in work force and community productivity from occupational accidents and disease and road maintenance requirements for transport also appear to be significant. Further assessment is needed to verify assumptions and characterize additional data bases.

0170 Legislation And Regulations

REFER ALSO TO CITATION(S) 28072, 28813, 29217, 29235

28154 (CONF-810498—(Vol.2), pp 615-622) **Development of standards and practices for coal-oil mixture technology.** Batra, S.K. (New England Power Service Co., Westborough, MA); Kurtzrock, R.C. 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

In the past few years, coal-oil mixture technology application is growing very rapidly for both industrial and utility boilers. As the coal-oil mixture technology nears its commercialization, there is a need for uniform performance criteria, testing procedures, quality control, and development of practices for trouble-free and reliable utilization of this technology. With this in view, a Standards and Practices Committee has been formulated to establish criteria for process equipment, instrumentation, characterization of coal-oil mixtures, combustion characteristics, and environmental controls for industrial and utility applications. To assist in the formulation of these standards and practices, five subcommittees have been set up in the areas relating to instrumentation, combustion, rheology/COM characterization, process equipment, and environment. The paper presents the goals and objectives of the various subcommittees, with special reference to the various efforts underway in the establishment of guidelines for selection and specifications of the equipment and for physical and chemical characterization of coal-oil mixtures. The work carried out by the various subcommittees will also be highlighted in this paper.

28155 **(DOE/OR/03054—T6) SRC-I PSD permit application.** (International Coal Refining Co., Allentown, PA (USA)). 15 Jul 1981. Contract AC05-78OR03054. 70p. NTIS, PC A04/MF A01. Order Number DE81026457.

Questions raised by the Kentucky Division of Air Pollution Control concerning the Prevention of Significant Deterioration Permit for the SRC-I Demonstration Plant are addressed in this report. Responses to each question are included. Also included is a section on mitigation of start-up, shutdown, and upset emissions. (DMC)

28156 **(DOE/PC/30162—1) Permit application handbook.** (Mining and Reclamation Council of America, Washington, DC (USA); Energy and Environmental Analysis, Inc., Arlington, VA (USA)). 23 Jun 1981. Contract AC22-80PC30162. 447p. NTIS, PC A19/MF A01. Order Number DE81027144.

The objective of this handbook is to explain how to prepare a mining permit application which will satisfy the requirements of the Federal Surface Mining Control and Reclamation Act of 1977 (SMCRA) (Public Law 95-87). The requirements described in this Handbook come from the permanent program regulations issued by the Office of Surface Mining (OSM) on March 13, 1979 and the court decisions and regulatory changes up until June 1981. This Handbook was developed to provide mine operators, particularly operators of small Appalachian mines, with an explanation of the Federal permit application requirements and the work which will be entailed in satisfying these requirements. Requirement explanations in the following areas are presented: site description; surface waters; ground waters; cultural resources; road; topsoil handling; blasting plans; water quality control; excess spoil disposal; reclamation plan; and special mining conditions. (DMC)

02 PETROLEUM

0203 Drilling And Production

REFER ALSO TO CITATION(S) 28167, 28596, 28686

28157 **(CONF-810718—) 1981 annual heavy oil/EOR contractor reports: proceedings.** (Department of Energy, San Francisco, CA (USA). San Francisco Operations Office). Jul 1981. 257p. NTIS, PC A12/MF A01. Order Number DE81027072.

From Annual heavy oil/EOR contractor report meeting; San Francisco, CA, USA (27 Jul 1981).

The 1981 Heavy Oil/EOR Meeting was held in San Francisco, Calif., July 28 to 30. Twenty-two papers were presented on enhanced oil recovery by applications of thermal processes, chemical flooding, and miscible flooding. Reports included field projects, basic research, and environmental studies. Abstracts are provided for each report in this Proceedings.

28158 **(DOE/BC/00047—T1) Development of improved mobility control agents for surfactant/polymer flooding. Second annual report, February 1-December 31, 1980.** Martin, F.D.; Donaruma, L.G.; Hatch, M.J. (New Mexico Inst. of Mining and Technology, Socorro (USA); New Mexico Inst. of Mining and Technology, Socorro (USA). New Mexico Petroleum Recovery Research Center). Jun 1981. Contract AC19-78BC00047. 127p. (EMD—2-67-3321). NTIS, PC A07/MF A01. Order Number DE81026191.

During the second year of the project, the baseline testing of commercial products was completed. These baseline tests with polymers include studies on mobility control, retention, and shear degradation in Berea cores, the effect of common ions on rheological properties, thermal stability, microbial degradation, and surfactant-polymer interactions. Work was also initiated on the synthesis, characterization, and preliminary screening of new and modified polymers. The modified materials consist of polymers analogous to the commercially available synthetic polymers as well as other polymer types, with specific structural alterations. The preliminary testing consists of measurements of shear degradation and viscosity loss in NaCl brines. To date, a number of potential structure-utility relationships have been observed. Solution viscosities of all nonionic polymers tested are essentially insensitive to changes in NaCl concentration. Increasing the charge-to-mass ratio (degree of hydrolysis) of either polyacrylamides or N-alkyl analogs enhances the ability of these polymers to build viscosity in low salinity NaCl brines. However, such polymers are increasingly subject to viscosity loss as the salinity is increased. Above a certain critical molecular weight, polymers become more susceptible to shear degradation. Many of the polymers that possess stiffer backbones exhibit improved brine and shear stability. 51 figures, 24 tables.

28159 **(DOE/BC/10007—12) Low interfacial tension and miscibility studies for surfactant tertiary oil recovery processes. Annual report, December 1, 1979-November 30, 1980.** Miller, C.A.; Fort, T. Jr. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Chemical Engineering). Mar 1981. Contract AS19-79BC10007. 73p. NTIS, PC A04/MF A01. Order Number DE81027212.

Polymer addition to an aqueous surfactant solution causes phase separation when the solution is initially a single liquid crystalline phase or a dispersion of liquid crystal in brine but not when the solution is an isotropic phase containing no liquid crystal. The resistance of randomly coiled polymer molecules to configurational change is the underlying cause of the phase separation. These results provide a basis for understanding and subsequently eliminating phase separation due to polymer-surfactant interactions in micellar-polymer recovery processes. A theory of drop size in microemulsions has been developed which includes an improved model of the surfactant films at the drop surfaces. Its most significant novel feature is a lattice model of the hydrocarbon chain region of the film which allows the amount of oil penetrating the film to be determined. The first portion of the theory discussed herein deals with nonionic surfactants. It predicts, among other things, the effect of oil chain length on drop size and inversion conditions. The theory thus offers good prospects of explaining for the first time the observed alkane carbon number effect on microemulsion behavior. A novel concept for reducing sensitivity of ultralow interfacial tensions to salinity is being investigated. It is discussed fully in an appendix to the report.

28160 **(DOE/ET/12044—T7) Pilot demonstration of enhanced oil recovery by micellar-polymer waterflooding. Quarterly report, second quarter, 1980: Phase D.** Staub, H.L. (Long Beach, City of, CA (USA)). 31 Jul 1980. Contract AC03-77ET12044. 19p. NTIS, PC A02/MF A01.

Response to the micellar-polymer injection continued during the quarter with no significant changes in total pool performance. The pool oil rate increased and the water-oil ratio declined, but the rate of change of both parameters appeared to be levelling off. Well T-104, the first well to display production response to chemical flood, has reversed the favorable trend and shows a reduction in both oil rate and oil cut. Several wells were off production during the quarter with numerous problems, predominantly sand control problems. The polymer buffer, currently at a concentration of about 2200 ppM, has continued to be injected at a fairly constant rate of 2000 B/D with no major upsets. Approximatey 39 percent of a pore volume has been injected.

28161 **(DOE/ET/12057—7) Bodcau in-situ combustion project produced fluids analyses.** Fulford, R.S. (Cities Service Co., Tulsa, OK (USA). Energy Resources Group). Jul 1981. Contract AC03-76ET12057. 68p. NTIS, PC A04/MF A01. Order Number DE81025168.

Produced oil, gas and water were analyzed seven times from 1976 to 1979 to evaluate the Bodcau Fireflood Project in the Bellevue Field in Louisiana. The oil produced during the fireflood was lighter compared to native oil. The viscosity decreased from native oil viscosity and the API gravity increased slightly. The percent low temperature boiling components increased in 1978 to 1979. In 1980 the boiling point curves became slightly heavier and were similar to 1978 oils. The sulfur content of the crude oil decreased during the early part of the fireflood and then increased. The increase in the hydrogen sulfide in the produced gas shows that crude oil sulfur is being converted to hydrogen sulfide by the fireflood. No SO_2 or COS was found in produced gas. The crude oil acid number decreased from 5.1 in native oil to 2.9 in May 1979. The lowering of the acid number is due to removal of sulfur and other components from the crude oil. The acid number in March 1980 oils increased to 4.3 indicating that native oils that are relatively unchanged by the fireflood are produced late in the project. This acid number increase made the water in oil emulsion more difficlut to break. The emulsions have higher viscosities. The emulsions also have viscosity variations with shear rate (non-Newtonian behavior) compared to Newtonian viscosities of the oil without emulsified water. The produced combustion gas was a mixture of N_2, CO_2, CO, O_2, H_2O and hydrocarbons. No NH_3 or nitrogen oxides were found. The average CO concentration varied from 0.34 to 0.61%. The low CO concentration indicates that any excess CO initially formed further reacts to form CO_2 or CH_4. The CH_4 concentration increased during the wet combustion phase of the fireflood, probably by reduction of CO. The water salinity decreased throughout the project. 10 figures, 35 tables. (DLC)

28162 **Transient rate decline analysis for wells produced at constant pressure.** Ehlig-Economides, C.A.; Ramey, H.J. Jr. (Stanford Univ, Calif). *SPEJ, Society of Petroleum Engineers Journal ;* **21**: No. 1, 98-104(Feb 1981).

Fundamental considerations suggest that conventional pressure drawdown and buildup analysis methods developed for constant-rate production should not be appropriate for a well produced at a constant pressure. However, a well produced at a constant pressure exhibits a transient rate decline which can be analyzed using techniques analogous to the methods for constant-rte flow. In this study, analytical solutions for the transient rate decline for wells produced at constant pressure are used to determine practical well test analysis methods. 18 refs.

0206 Health And Safety

REFER ALSO TO CITATION(S) 28164, 29354

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 28149, 28150, 28151, 28815

28163 **(MTR—81W14) Naval Petroleum Reserves: assessment of alternative operating strategies beyond 1982. Analysis and supporting data.** Gsellman, L.R.; Mendis, M.S.; Rosenberg, J.I. (Mitre Corp., McLean, VA (USA). METREK Div.). Jun 1981. Contract AC01-80RA32101. 258p. NTIS, PC A12/MF A01. Order Number DE81028537.

Legislation authorizing production from two of the Naval Petroleum Reserves, i.e., NPR-1 (Elk Hills, California) and NPR-3 (Teapot Dome, Wyoming), expires in 1982. This paper presents analyses and supporting data concerning the trade-offs of extending production or returning to a shut-in status in order to provide the Department of Energy with information needed to formulate a recommendation. The primary objective of the study is to evaluate a range of possible futures (through 1990) to determine technical, economic, energy, strategic and political trade-offs between the two options. A secondary objective is to develop a data base for use by DOE to respond to questions and issues raised by interested parties during executive branch and Congressional reviews.

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 28133, 29241, 29245

28164 (MTR—81W77) Health and environmental effects of oil and gas technologies: research needs. Brown, R.D. (Mitre Corp., McLean, VA (USA). METREK Div.). Jul 1981. Contract AC01-79EV10018. 704p. NTIS, PC A99/MF A01. Order Number DE81027889.

Report to the Federal Interagency Committee on the Health and Environmental Effects of Energy Technologies.

This report discusses health and environmental issues associated with oil and gas technologies as they are currently perceived - both those that exist and those that are expected to emerge over the next two decades. The various sections of this report contain discussions of specific problem areas and relevant new research activities which should be pursued. This is not an exhaustive investigation of all problem areas, but the report explores a wide range of issues to provide a comprehensive picture of existing uncertainties, trends, and other factors that should serve as the focus of future research. The problem areas of major concern include: effects of drilling fluids, offshore accidents, refineries and worker health, and biota and petroleum spills, indoor air pollution, information transfer, and unconventional resources. These are highlighted in the Executive Summary because they pose serious threats to human health and the environment, and because of the sparcity of accumulated knowledge related to their definition. Separate abstracts have been prepared for selected sections of this report for inclusion in the Energy Data Base. (DMC)

0210 Legislation And Regulation

REFER ALSO TO CITATION(S) 28154, 28802, 29217, 29255, 29256

0220 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 28078, 28105, 28110, 28111, 28112, 28113, 28114, 28116, 28128, 28135

0230 Properties

REFER ALSO TO CITATION(S) 28073, 28074, 28075, 28076, 28077, 28078, 28133, 28142, 28161, 28600, 28603, 28605

0240 Storage

REFER ALSO TO CITATION(S) 28117, 28118, 28119, 28120, 28314

0250 Combustion

REFER ALSO TO CITATION(S) 28105, 28128, 28130, 28131, 28133, 28134, 28135, 28136, 28137, 28138, 28139, 28140, 28141, 28142, 28143, 28364, 28587, 28588, 28596, 28597, 28598, 28599, 28600

03 NATURAL GAS

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 28507

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 28084, 28522

0305 Health And Safety

REFER ALSO TO CITATION(S) 28164

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 28169

0308 Environmental Effects

REFER ALSO TO CITATION(S) 28164

0309 Artificial Stimulation

28165 (DOE/BC/10003—21) Western gas sands project. Status report, January-March 1981. (CER Corp., Las Vegas, NV (USA)). 1981. Contract AC08-79BC10003. 122p. NTIS, PC A06/MF A01. Order Number DE81027278.

Progress of government-sponsored projects which are directed toward increasing gas production from low permeability gas sands of the Western United States is summarized. During the quarter, two wells were cored and logged: Mountain Fuel Supply Company Mesa Unit No. 2 in Sublette County, Wyoming, and Coors Energy Getty 1-7 in Garfield County, Colorado. Conventional core analysis and CEC analysis were received for the wells cored during the previous quarter. The investigation at Bartlesville Energy Technology Center of the use of a semi-automated method for cation exchange capacity (CEC) determinations was completed. At Lawrence Livermore National Laboratory, small scale laboratory experiments have continued to study crack growth in asymmetric non-uniform stress fields. Effort was spent at Los Alamos National Laboratory on shortening the NMR coil ring-down and receiver dead time following a transmitter pulse and in determining the source of a beat signal received following the transmitter pulse. At Sandia National Laboratories, two principal activities have been conducted regarding cross-borehole seismic investigations. Further analysis of data from the cyclic dry gas experiment with Colorado Insterstate Gas Company confirmed the initial assessment that no further improvement in productivity was effected as a result of the second five-month cycling period.

28166 (SAND—81-1399C) Multiple fracturing technique for enhanced gas recovery. Cuderman, J.F.; Cooper, P.W.; Chen, E.P.; Northrop, D.A. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 9p. (CONF-810909—3). NTIS, PC A02/MF A01. Order Number DE81023162.

From Institute of Gas Research conference; Los Angeles, CA, USA (28 Sep 1981).

The use of progressively burning propellants is a promising new technique for producing multiple fractures in a wellbore. Three series of multiple fracturing experiments have been conducted under realistic in situ conditions and directly observed by mineback in a tunnel complex at the Nevada Test Site. The first two series (1-3) showed that multiple fracturing by propellant deflagration is feasible and depends most critically on the initial pressure loading rate produced by the propellant burn. The most recent series verified scaling criteria developed by semi-empirical and analytical modeling. It showed that results from small scale tests can be adequately scaled and that they can provide an effective method for investigating and optimizing multiple fracture generation and

extension, for developing optimum propellants for multiple fracturing, and testing technologies such as forcing proppant into fractures.

28167 (UCRL—85189) Tailored-pulse loading conditions for multiple fracturing of boreholes. Swift, R.P.; Kusubov, A.S. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 7 May 1981. Contract W-7405-ENG-48. 16p. (CONF-810624—11). NTIS, PC A02/MF A01. Order Number DE81027220.

From 22. US symposium on rock mechanics; Cambridge, MA, USA (29 Jun 1981).

Tailored-pulse loading conditions to produce multiple fracturing of boreholes are examined for sandstone samples having a dry density of 2.42 Mg/m^3 and 8.9% porosity. Experiments are performed with borehole pressures ranging from 10 to 100 MPa, loading rates from 10^{-4} to 10^{2} MPa/ms, and pulse durations from 1 to 50 ms. Samples are tested for initial states of dry, quasi-dry, and total saturation, with confinement pressure varying from 0.1 to 50 MPa. Data show sensitivity of multiple fracture initiation on loading rate, water content, and confining pressure. The threshold-breakdown pressure increases proportionately with the loading rate. For quasi-dry and wet conditions, the loading rate for the onset of multiple fracturing decreases with increasing water content and with increasing confining pressure. When fluid intrusion around the borehole is prevented, only two fractures occur in dry samples, regardless of the loading rate or confinement conditions. These effects indicate that pore-fluid mechanisms, which result in a transient increase in pore pressure in the vicinity of the borehole, are responsible for multiple fracture initiation at intermediate loading rates. This influence of pore fluid suggests that higher permeable source rock may be more susceptible to multiple fracturing than low permeable rock. 6 figures.

28168 (UCRL—86283) Fracture initiation using tailored-pulse loading. Kusubov, A.S.; Swift, R.P. (Lawrence Livermore National Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 6p. (CONF-810684—38). NTIS, PC A02/MF A01. Order Number DE81026218.

From APS conference on shock waves in condensed matter; Menlo Park, CA, USA (23 Jun 1981).

Conditions to produce multiple fracturing of boreholes are examined for sandstone samples having a dry density of 2.42 Mg/m^3 and 8.9 percent porosity. Tailored-pulse loading experiments are performed with borehole pressures ranging from 10 to 100 MPa, loading rates from 10^{-4} to 10^{2} MPa/ms and pulse durations from 10 to 50 ms. Samples are tested for initial states of dry, quasi-dry, and total saturation with confinement pressure varying from 0.1 to 50 MPa. Data show sensitivity of multiple fracture initiation on loading rate, water content, and confinement pressure.

0310 Legislation And Regulation

28169 (DOE/RA/50145—T1) Early effects of the Natural Gas Policy Act of 1978 on US gas supply. (Jensen Associates, Inc., Boston, MA (USA)). Apr 1981. Contract AC01-80RA50145. 57p. NTIS, PC A04/MF A01. Order Number DE81026217.

The principal conclusions of this study are as follows: The National Gas Policy Act (NGPA) has influenced both the amount and the type of gas well drilling activity, although many of the same influences were being exerted prior to NGPA by the National Rate pricing system. The number and footage of gas well completions have, under NGPA, continued to increase, and the share of development drilling in total gas well drilling has also continued to grow, at least through 1979. Many respondents felt that NGPA had induced a surge of developmental gas drilling activity, but no evidence is found of any such acceleration after 1978 in the available data. On the other hand, NGPA clearly has not discouraged development drilling. Indeed, some respondents felt that NGPA provided an incentive to drill new wells which replace existing producing wells, thereby qualifying old gas for higher Section 103 prices. Conclusions about NGPA effects upon reserve additions and production must be inferred from drilling statistics, since data on reserves and production are not published as promptly as data on drilling. In addition to affecting drilling activity, NGPA has also influenced the distribution of available supplies of gas. By removing most of the barriers between intrastate and interstate markets, the Act has relieved local shortage and surplus situations and contributed to a more rationalized allocation of gas.

28170 Natural gas supply under the Natural Gas Policy Act of 1978. Kalisch, R.B. San Mateo, CA; Pacific Coast Gas Association (1980). 25p. (CONF-8003142—6).

From Pacific Coast Gas Association operating section transmission conference; Salt Lake City, UT, USA (31 Mar 1980).

The problem of supplying natural gas to the nation over the next 20 years was discussed. The issues of how much gas can be produced from the conventional, Lower-48 resources and how the supplemental sources of gas to provide adequate gaseous fuel to the nation can be developed were discussed with the aid of many slides. It was noted that coal reserves are adequate to satisfy our long-term energy needs, but there has been no significant shift to coal as other fuels have become limited in supply. Further, it had been hoped that nuclear power could carry an increasing part of the energy load, but to date it only supplies about 4% of the national energy need. Natural gas is generally less expensive than other fuels. Prior to the Natural Gas Policy Act, the federal government controlled the price of interstate natural gas at the wellhead. Passage of the Act altered the structure of the market. Gas-well completions have increased, but reserve additions in the Lower-48 are decreasing because wells are being completed in areas where drilling prices are more economical, and the potential for gas is less. The nation's planners have concluded that natural gas can and should play a larger role in the future than that depicted in NEP II Lower-48 conventional production forecast. A list of supplemental gas sources is presented which includes Alaskan gas production, Canadian and Mexican imports, LNG imports, oil and coal gasification, and new technologies (gas from Devonian shales, tight sands, biomass, geopressured areas, and peat gasification). (MCW)

0320 Transport, Pipelines, And Handling

28171 (FERC/EIS—0024) Rocky Mountain Pipeline project: graphic supplement. Environmental impact statement. (Federal Energy Regulatory Commission, Washington, DC (USA). Office of Pipeline and Producer Regulation; Bureau of Land Management, Washington, DC (USA); Rocky Mountain Pipeline Co., San Francisco, CA (USA)). Jul 1981. 144p. NTIS, PC A07/MF A01. Order Number DE81026112.

This Graphic Supplement contains all of the major maps which support the text of the Rocky Mountain Pipeline Project (RMPP) Environmental Impact Statement (EIS). It is not expected that changes will be made to these maps between the publication of the draft EIS and the final EIS. All base information for maps was derived from various US Geological Survey (USGS) maps. The following maps are contained in the Graphic Supplement: S-1 - Project Overview Map; S-2 through S-19 - Maps showing the routes of the proposed action, alternatives and variations; S-20 - Central Nevada Alternative; S-21 - Fort Mojave Variation; S-22 - East Las Vegas Area; S-23 - Location of Maintenance Bases and Double Jointing Yards; and S-24 - Vegetation Type Map. The presentation of information for the RMPP on these maps, particularly the route positioning, is only approximate. The pipeline route position for the proposed action, alternatives, and variations varies within a 1-mile wide corridor.

0340 Combustion

REFER ALSO TO CITATION(S) 28363

04 OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 28692

0403 Drilling, Fracturing, And Mining

28172 **(DOE/ET/13090—T1) Oil shale in-situ research and development. Quarterly report No. 4, May 1-July 31, 1978.** Goldstein, K.M. (Talley Energy Systems, Inc., Scottsdale, AZ (USA)). 1978. Contract AC03-78ET13090. 57p. NTIS, PC A04/MF A01.

This period encompassed many of the preparatory operations prior to the explosive fracturing event at Rock Springs Site Section 17. During May, the last two hydraulic fracturing operations were completed. In June, post hydrofracture evaluation studies were performed. During July, six instrumentation wells were completed and several surveys conducted. (DLC)

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 28178, 28683

28173 **(DOE/ER/30010—1) Assessment of oil-shale technology in Brazil. Final technical report, October 27, 1980-July 27, 1981.** (International Science and Technology Inst., Inc., Washington, DC (USA)). 27 Jul 1981. Contract AC01-80ER30010. 143p. NTIS, PC A07/MF A01. Order Number DE81027574.

The development of an oil shale industry in the United States will require the solution of a variety of technical, economic, environmental, and health and safety problems. This assessment investigates whether US oil shale developers might benefit from the experience gained by the Brazilians in the operation of their Usina Prototipo do Irati oil shale demonstration plant at Sao Mateus do Sul, and from the data generated from their oil shale research and development programs. A chapter providing background information on Brazil and the Brazilian oil shale deposits is followed by an examination of the potential recovery processes applicable to Brazilian oil shale. The evolution of the Brazilian retorting system is reviewed and compared with the mining and retorting proposed for US shales. Factors impacting on the economics of shale oil production in Brazil are reviewed and compared to economic analyses of oil shale production in the US. Chapters examining the consequences of shale development in terms of impact on the physical environment and the oil shale worker complete the report. Throughout the report, where data permits, similarities and differences are drawn between the oil shale programs underway in Brazil and the US. In addition, research areas in which technology or information transfer could benefit either or both countries' oil shale programs are identified.

28174 **(DOE/LC/10747—T2) Laboratory modeling of in-situ retorting of oil shale by superheated-steam injection. BX in-situ oil shale project.** Dougan, P.M. (Equity Oil Co., Salt Lake City, UT (USA)). 3 Aug 1981. Contract FC20-78LC10747. 135p. NTIS, PC A07/MF A01. Order Number DE81025433.

The laboratory study has shown that retorting of oil shale by a superheated steam is practical; yield of evolved product is given by 1-X = 1-e/sup Kt/, where K = -4.83 x $10^{14}e^{-}$/sup 22,900/T/. Evolved oil has a high pour point 70 to 82°F low API gravity ~ 21, but it is cracked in steam above 525°F, resulting in in-situ recovered oil with low pour point below 30°F. The Parachute Creek formation contains carbonates and bicarbonates which accounts for nearly all the CO_2 in the off-gases; thus no water-shift or water-gas reaction probably is taking place. The oils have lower molecular weight and larger fractions of naptha, light distillate and light gas oil than ordinary shale oils. The nitrogen, sulfur, and oxygen are lowered. The steam cracking leads to a less polar product. 48 figures. (DLC)

28175 **(UCID—19093) Effect of steam on H_2, CO_2, H_2S, CO, and COS concentrations in combustion-retort offgas.** Burnham, A.K. (Lawrence Livermore National Lab., CA (USA)). 16 Jul 1981. Contract W-7405-ENG-48. 19p. NTIS, PC A02/MF A01. Order Number DE81027836.

The effect of steam on the offgas composition of combustion retorts was determined by interrupting the otherwise continuous steam flow in S-24 for one hour while other variables, including temperature, remained relatively constant. The offgas composition was determined by frequent gas analyses. The largest effect of interrupting the steam flow was to decrease the rate of H_2 production by a factor of 2.6, primarily due to elimination of one H_2O-char reaction. The rate of CO_2 production decreased by a factor of 1.7. After subtracting the CO_2 production due to carbon combustion, this result implies that steam accelerates the rate of carbonate decomposition by a factor of 3.0. In the absence of steam, the H_2S production rate dropped by a factor of 1.5, indicating the importance of steam-iron sulfide reactions. Finally, the production rates of CO and COS increased by factors of 1.5 and 1.7. These results are compared to results from laboratory studies of oil shale chemistry and to gas production during other parts of this and other LLNL pilot retort runs. Finally, the ability of steam to significantly decrease the pour point of shale oil from combustion retorts is noted.

0405 Properties And Composition

REFER ALSO TO CITATION(S) 28174

28176 **(LA-UR—81-1850) Physical and chemical characterization and comparison of solids, liquids, and oils derived from Estonian and Green River formation shales.** Peterson, E.J.; Spall, W.D. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 19p. (CONF-810676—4). NTIS, PC A02/MF A01. Order Number DE81025345.

From 2. joint US-USSR workshop on the health and environmental effects of oil shale development; Tallinn, USSR (22 Jun 1981).

Although only a single Estonian raw shale sample with an unknown history has been examined, physical and chemical characterization of this material has been accomplished. A comparison with a representative Green River formation raw shale has been made. Some of the findings are: (1) Elemental analysis indicates that the major elements, aluminum, magnesium, and sodium are deficient in Estonian shale compared to the Green River shale. The minor elements, barium and strontium, and the trace elements, arsenic, cobalt, rare earths, uranium, vanadium, and zinc are also deficient in the Estonian shale compared to the Green River shale. (2) Green River shales contain greater quantities of clay minerals (mainly illite) compared to the Estonian shale. (3) X-ray diffraction data suggests that α-quartz concentration in the Estonian material is two to three times less than in typical Green River shales. (4) The suite of minerals in the Estonian spent shale suggests extreme processing conditions. (5) Scanning electron microscopy-electron microprobe analysis results indicate the intimate contact of the minerals on the micron level in the Green River shales. Mineral grains in the Estonian shale are dispersed throughout the organic material. (6) Aqueous leaching experiments indicate lead mobility from the Estonian spent materials result in concentrations that are undesirably high. (7) Phenolic compoundsare the most concentrated organic species present in the aqueous Estonian leachates. By comparison, carboxylic acids are the most concentrated species in the Green River leachates. (8) The Estonian raw shale sample has a Fischer assay of 93 barrels per ton, and the Green River an assay of 26 barrels per ton. (9) Organic solvent extraction of the raw shales with 15 different solvents show that approximately 60% of the kerogen in the Green River shale is extractable and only 3.8% of the Estonian shale is extracted under the same conditions.

0407 Health And Safety

REFER ALSO TO CITATION(S) 28173, 29354, 29355

0408 Marketing And Economics

REFER ALSO TO CITATION(S) 28173

0409 Waste Research And Management

REFER ALSO TO CITATION(S) 28090

28177 (LA-UR—81-1903) Control strategies for mitigation of oil-shale-related-water quality concerns. Peterson, E.J.; Wagner, P. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 18p. (CONF-8106109—2). NTIS, PC A02/MF A01. Order Number DE81025332.

From Workshop on processing needs and methodology for wastewaters from the conversion of coal, oil shale and biomass to synfuels; Germantown, MD, USA (Jun 1981).

A comprehensive study of in situ retorting at the Logan Wash has indicated the importance of developing baseline information including raw shale characterization, the elucidation of mineralogical and chemical controls on trace element mobilities from shales subjected to in situ processing, and the research necessary to identify strategies for control of recognized environmental impacts. It is impossible to assess the magnitude of trace element releases to be expected from a commercial in situ facility once banks of retorts or the entire facility is abandoned and dewatering of the area is concluded. However, laboratory-scale studies can indeed identify the relative environmental acceptability of spent shale materials generated by in situ processing. In this research, an attempt was made to relate mineralogy and leaching behavior of field-generated materials with leachate composition and solution chemical processes. The interaction of these factors will ultimately affect the impact of in situ processing on surface and groundwater quality.

0410 Enviromental Aspects

28178 (LBL—12063) Hydrogeologic consequences of the modified in-situ retorting process, Piceance Creek Basin, Colorado. Mehran, M.; Narasimhan, T.N.; Fox, J.P. (Lawrence Berkeley Lab., CA (USA)). Apr 1981. Contract W-7405-ENG-48. 14p. (CONF-810456—5). NTIS, PC A02/MF A01. Order Number DE81027090.

From 14. oil shale symposium; Golden, CO, USA (22 Apr 1981).

This study is aimed at studying the possible alteration of the groundwater regime in and around the C-a and the C-b tracts due to the proposed MIS strategies. Results suggest that mine-inflow rates will gradually increase with time and that the phreatic surface will be drawn down significantly over several square kilometers around the C-a and C-b tracts. These drawdowns could have profound effects on the shallow groundwater and surface water supplies. The expected inflow rates may vary from 0.15 to 1.4 m^3/s at the C-a tract and from 0.5 to 0.9 m^3/s at the C-b tract. The computations suggest that over a 30-y period of activity at the C-a tract, the water table in the vicinity of a tributary to the Yellow Creek may be drawn down by as much as 31 m. Similarly, 60 years of MIS retorting at the C-b tract may draw down the water table in the vicnity of the Piceance Creek by 100 m or more. The studies indicate that in an expanding mine, the inflows are likely to be concentrated in the neighborhood of newly excavated regions where hydraulic gradients will be highest. It has been estimated that inflow into individual retorts may vary from 0.15×10^{-3} to 0.95×10^{-3} m^3/s. These infow rates may or may not have significant effects on combustion efficiency, depending upon such factors as shale richness, uniformity of flow, and steam-air ratio. Higher porosities, lower residual saturations, and higher permeabilities will tend to increase mine inflows. 16 figures, 3 tables.

0420 Regulations

REFER ALSO TO CITATION(S) 29257

05 NUCLEAR FUELS

0501 Reserves

REFER ALSO TO CITATION(S) 28776

28179 (GJBX—132-81) Geology and uranium favorability of the Sonora Pass region, Alpine and Tuolumne Counties, California. Rapp, J.S.; Short, W.O. (Bendix Field Engineering Corp., Grand Junction, CO (USA); California State Dept. of Conservation, Sacramento (USA). Div. of Mines and Geology). Jun 1981. Contract AC13-76GJ01664. 153p. NTIS, PC E06/MF $3.50. Order Number DE81026178.

Includes 3 sheets of 24 reduction microfiche.

Uranium mineralization at the Juniper Mine is restricted to host rocks of the Relief Peak Formation and is most common in coarse-grained lithic sandstone, conglomerate, and lithic wacke. The richest beds contain as much as 0.5% U_3O_8. Uranium is present as coffinite, uraninite, and unidentified minerals. Thorium/uranium ratios are generally low and erratic. Equivalent uranium determinations are low in comparison with chemical uranium values, indicating that uranium mineralization of the Juniper Mine is geologically young. Core drilling at 16 localities shows that widely separated exposures of the Relief Peak Formation have very similar lithology, geochemistry, and stratigraphy. Some sections are similar to the Juniper Mine section. Core from the bottom of drill hole SP-1 contains 83 ppM uranium, the greatest known concentration outside the mine area. Significant uranium deposits may be concealed beneath the thick Tertiary volcanic cover of the region. The quartz latitic Eureka Valley Tuff is fairly widespread in east-central California and western Nevada. It contains 12 to 14 ppM uranium and stratigraphically overlies the Relief Peak Formation. It is permeable and contains abundant alkali metals and volcanic glass. Because of its petrology, geochemistry, and position, this formation is the most likely source for uranium mineralization of the Sonora Pass region. It should be examined as a potential source rock in other areas with special regard to its relationship to carbonaceous sedimentary formations. The uraniferous granite pegmatitite dike that crops out in the Niagara Creek area appears too small to be a significant source rock. The most favorable rocks in the Sonora Pass region occur near the Juniper Mine and west of it, in the Dardanelles, the Whittakers Dardanelles, and the area of the Big Meadow Quadrangle. Potential uranium host rocks crop out in areas along the crest of the Sierra Nevada from Lake Tahoe to Yosemite.

0502 Exploration

REFER ALSO TO CITATION(S) 28179, 29132, 29225

28180 Regional geochemical patterns in Wyoming and northern Colorado as defined by analyses of stream sediment samples. Warren, R.G.; Minor, M.M.; Thomas, G.J. (Los Alamos Sci Lab, NM). pp 39-48 of Annual uranium seminar, 4th, 1980. New York, NY; Soc. of Min. Eng. of AIME (1980).

Los Alamos Scientific Laboratory initiated effort in the Hydrogeochemical and Stream Sediment Reconnaissance (HSSR), a part of the Department of Energy National Uranium Resource Evaluation program, in 1975. The paper summarizes results for seven elements and uranium/thorium ratios in sediment samples for a region that includes all of Wyoming and portions of adjacent states. Geochemical patterns are presented for uranium, a suite of chemically immobile elements generally associated with uranium (thorium, cerium, ytterbium, and hafnium), and two chemically immobile elements (chromium and titanium) generally not associated with uranium. 24 refs.

28181 (GJBX—170-81) Hydrogeochemical and stream sediment reconnaissance basic data for Bay City NTMS Quadrangle, Texas. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 31 Mar 1981. Contract W-7405-ENG-26. 223p. (K/UR—149). NTIS, PC E07/MF $3.50. Order Number DE81025025.

Includes 1 sheet of 48x reduction microfiche.

Results of a reconnaissance geochemical survey of the Bay City Quadrangle, Texas are reported. Statistical data and areal distributions for uranium and uranium-related variables are presented for 55 groundwaters and 46 stream sediment samples. Also included is a brief discussion on location and geologic setting. The Bay City Quadrangle is represented by a small area with relatively simple surface and subsurface geology. Two stratigraphic units are exposed at the surface and only one aquifer system supplies the groundwater samples. The results of the groundwater geochemical analysis show uranium associated with saline waters thus indicating possible salt water infiltration from the Gulf. The geochemical results from the analysis of stream sediments indicate uranium in association with resistate mineral indicators.

28182 **(GJBX—190-81) Montgomery and parts of Meridian, Hattiesburg, and Andalusia 1° x 2° NTMS areas, Alabama: data report (abbreviated).** Bennett, C.B. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1981. Contract AC09-76SR00001. 18p. (DPST—81-146-3). NTIS, PC E04/MF $6.50. Order Number DE81026343.

Includes 21 sheets of 24x reduction microfiche.

This abbreviated data report presents results of partial ground water and stream sediment reconnaissance in the National Topographic Map Series (NTMS) Montgomery, Meridian, Hattiesburg, and Andalusia 1° x 2° quadrangles. Neutron activation analyses (NAA) results are given for uranium and 16 other elements in sediments, and for uranium and 8 other elements in ground water and stream water. Field measurements and observations are reported for each site. Analytical data and field measurements are presented in tables and maps. Data from ground water and stream water sites include (1) water chemistry measurements, (pH, conductivity, and alkalinity), (2) physical measurements where applicable (water temperature, well description) and (3) elemental analyses (U, Al, Br, Cl, Dy, F, Mn, Na, V, and, when available, He). Areal distribution maps, histograms, and cumulative frequency plots for most elements and measurements for ground water and stream water in the Montgomery quadrangle are included. Data from sediment sites include (1) stream water chemistry measurements and (2) elemental analyses for sediment samples (U, Th, Hf, Al, Ce, Dy, Eu, Fe, La, Lu, Mn, Sc, Sm, Na, Ti, V, and Yb). Sample site descriptors (stream characteristics, vegetation) are also tabulated. Areal distribution maps, histograms, and cumulative frequency plots for most elements and measurements for stream sediments in the Montgomery quadrangle are included. Uranium concentrations in the sediments ranged from 0.2 to 112 ppM with an average of 7.73 ppM. Uranium concentrations in ground water samples ranged from 0.006 to 87.32 ppB with an average of 0.252 ppB. Uranium concentrations in stream water samples ranged from 0.010 to 0.112 ppB with an average of 0.076 ppB.

28183 **(GJBX—191-81) Birmingham and West Point 1° x 2° NTMS areas, Alabama: data report (abbreviated).** Bennett, C.B. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1981. Contract AC09-76SR00001. 18p. NTIS, PC E03/MF $4.30. Order Number DE81026340.

Includes 10 sheets of 48x reduction microfiche.

Sediment samples were collected at 898 and 102 sites in the Birmingham and West Point quadrangles, respectively. Ground water samples were collected at 1178 and 189 sites in the Birmingham and West Point quadrangles, respectively. Stream water samples were collected at 534 and 69 sites in the Birmingham and West Point quadrangles, respectively. Neutron activation analyses results are given for uranium and 16 other elements in sediments, and for uranium and 8 other elements in ground water and stream water. Field measurements and observations are reported for each site. Analytical data and field measurements are presented. Data from ground water and stream water sites include (1) water chemistry measurements (pH, conductivity, and alkalinity), (2) physical measurements, where applicable (water temperature, well description, etc.), and (3) elemental analyses (U, Al, Br, Cl, Dy, F, Mn, Na, V, and, when available, He). Areal distribution maps, histograms, and cumulative frequency plots for most elements and measurements for ground water and stream water in the Birmingham quadrangle are included. Data from sediment sites include (1) stream water chemistry measurements, and (2) elemental analyses for sediment samples (U, Th, Hf, Al, Ce, Dy, Eu, Fe, La, Lu, Mn, Sc, Sm, Na, Ti, V, and Yb). Sample site descriptors (stream characteristics, vegetation) are also tabulated. Areal distribution maps, histograms, and cumulative frequency plots for most elements and measurements for stream sediments in the Birmingham quadrangle are included on microfiche. Uranium concentrations in the sediments ranged from 0.3 to 31.2 ppM with an average of 4.12 ppM. Uranium concentrations in ground water samples ranged from 0.006 to 16.66 ppB with an average of 0.143 ppB. Uranium concentrations in stream water samples ranged from 0.006 to 2.3 ppB with an average of 0.076 ppB.

28184 **(GJBX—192-81) Binghamton 1° x 2° NTMS area New York: data report (abbreviated).** Cook, J.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1981. Contract AC09-76SR00001. 18p. (DPST—81-146-8). NTIS, PC E02/MF $3.90. Order Number DE81026341.

Includes 8 sheets of 24x reduction microfiche.

Results of ground water, surface water, and stream sediment reconnaissance in the National Topographic Map Series (NTMS) Binghamton 1° x 2° quadrangle are presented. Surface sediment samples were collected at 985 sites. Ground water samples were collected at 707 sites. Neutron activation analysis (NAA) results were given for uranium and 16 other elements in sediments, for uranium and 8 other elements in ground water, and for uranium and 9 other elements in surface water. Field measurements and observations are reported for each site. Analytical data and field measurements are presented. Data from ground water sites include (1) water chemistry measurements (pH, conductivity, and alkalinity), (2) physical measurements, where applicable (water temperature, well description), and (3) elemental analyses (U, Al, Br, Cl, Dy, F, Mn, Na, and V). Data from sediment sites include (1) stream water chemistry measurements (pH, conductivity, and alkalinity), and (2) elemental analyses for sediment samples (U, Th, Hf, Al, Ce, Dy, Eu, Fe, La, Lu, Mn, Sc, Sm, Na, Ti, V, and Yb). Sample site descriptors (stream characteristics, vegetation) are also tabulated. Areal distribution maps, histograms, and cumulative frequency plots for most elements and for U/Th and U/Hf ratios are included. Key data from stream water sites include (1) water quality measurements and (2) elemental analyses (U, Al, Br, Cl, Dy, F, Mg, Mn, Na, and V). Uranium concentrations in the sediments that were above detection limits ranged from 0.10 to 20.4 ppM. The mean of the logarithms of the uranium concentrations was 0.45. An area of high (>10 ppM) uranium concentrations occurs in the southwestern portion of the quadrangle from approximately Binghamton to Deposit, NY.

28185 **(GJBX—198-81) Hydrogeochemical and stream sediment reconnaissance basic data for Bettles Quadrangle, Alaska.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 29 May 1981. Contract W-7405-ENG-26. 123p. (K/UR—329). NTIS, PC E04/MF $3.50. Order Number DE81026184.

Includes 1 sheet of 48x reduction microfiche.

Field and laboratory data are presented for 910 water samples from the Bettles Quadrangle, Alaska. The samples were collected by Los Alamos Scientific Laboratory; laboratory analysis and data reporting were performed by the Uranium Resource Evaluation Project at Oak Ridge, Tennessee.

28186 **(GJBX—199-81) Hydrogeochemical and stream sediment reconnaissance basic data for Yakutat Quadrangle, Alaska.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 29 May 1981. Contract W-7405-ENG-26. 49p. (K/UR—334). NTIS, PC E02/MF $3.50. Order Number DE81026185.

Includes 1 sheet of 48x reduction microfiche.

Field and laboratory data are presented for 296 water samples from the Yakutat Quadrangle, Alaska. The samples were collected by Los Alamos Scientific Laboratory; laboratory analysis and data reporting were performed by the Uranium Resource Evaluation Project at Oak Ridge, Tennessee.

28187 (GJBX—209-81) Aerial gamma ray and magnetic survey: Marion quadrangle, Ohio. Final report. (EG and G GeoMetrics, Sunnyvale, CA (USA)). Jun 1981. Contract AC13-76GJ01664. 250p. PCE 09/MF $4.30. Order Number DE81027185.

Includes 8 sheets of 48x reduction microfiche.

The Marion quadrangle covers a 7200 square mile area of central Ohio located within the Midwestern Physiographic Province. Up to 5000 feet of Paleozoic strata overlie the east dipping Precambrian basement. Flat lying Quaternary glacial sediments cover most of the surface within the quadrangle. A search of available literature revealed no known uranium deposits. Ninety-nine uranium anomalies were detected and are duscussed briefly. Radiometric data appear to reflect a preference for uranium occurrences in glacial moraine tills, and a minimum likelihood of occurrence in Paleozoic bedrock. Some of the largest anomalies appear to be culturally induced and no anomaly was considered to represent a significant amount of naturally occurring uranium. The magnetic data contrast somewhat with the existing structural interpretation of the area. The generally increasng magnetic gradient from west to east is interrupted by many features whose sources may be attributed to undefined lithologic and/or structural elements in the Precambrian basement.

28188 (GJBX—214-81) One hundred prime references on hydrogeochemical and stream sediment surveying for uranium as internationally practiced, including 60 annotated references. Sharp, R.R. Jr.; Bolivar, S.L. (Los Alamos Scientific Lab., NM (USA)). Apr 1981. Contract W-7405-ENG-36. 92p. (LA—6647-MS). NTIS, PC A05/MF A01. Order Number DE81027985.

The United States Department of Energy (DOE), formerly the US ERDA, has initiated a nationwide Hydrogeochemical and Stream Sediment Reconnaissance (HSSR). This program is part of the US National uranium Resource Evaluation, designed to provide an improved estimate for the availability and economics of nuclear fuel resources and make available to industry information for use in exploration and development of uranium resources. The Los Alamos National Laboratory is responsible for completing the HSSR in the Rocky Mountain states of New Mexico, Colorado, Wyoming, and Montana and in the state of Alaska. This report contains a compilation of 100 prime references on uranium hydrogeochemical and stream sediment reconnaissance as internationally practiced prior to 1977. The major emphasis in selection of these references was directed toward constructing a HSSR program with the purpose of identifying uranium in the Los Alamos National Laboratory area of responsibility. Reports concerning the subsequent HSSR program developed by the Los Alamos National Laboratory, patterned after extensive reconnaissance done in over 20 other countries of which most are referenced herein, are available from the US DOE office in Grand Junction, Colorado. The context of the annotated abstracts are the authors' concept of what the respective article contains relative to uranium geochemistry and hydrogeochemical and stream sediment surveying. Consequently, in many cases, significant portions of the original articles are not discussed. The text consists of two parts. Part I contains 100 prime references, alphabetically arranged. Part II contains 60 select annotated abstracts, listed in chronological order.

28189 (GJBX—215-81) Detailed geochemical survey data release for the San Andres-Oscura Mountains special study area, New Mexico. LaDelfe, C.M. (Los Alamos Scientific Lab., NM (USA)). Apr 1981. Contract W-7405-ENG-36. 103p. (LA—8016-MS). NTIS, PC A06/MF A01. Order Number DE81027982.

The work reported here includes field data and the results of analyses for uranium and additional elements for each sample. This special study is a follow-up to the uranium reconnaissance previously conducted by Los Alamos in the surrounding Tularosa NTMS quadrangle as part of the Hydrogeochemical and Stream Sediment Reconnaissance (HSSR). The HSSR program is part of the United States Department of Energy (DOE) National Uranium Resource Evaluation (NURE), which is designed to provide an improved estimate of the available information for industry use in the development and production of uranium resources. Each rock sample collected for this special study was crushed and the minus 100-mesh fraction was put into a prewashed 25-ml polyethylene vial and a clean 4-ml rabbit before undergoing analysis. The possibility exists of sample contamination with crusher alloys, especially in the rhyolite samples. The samples were analyzed for uranium and thorium as well as aluminum, antimony, arsenic, barium, beryllium, bismuth, cadmium, calcium, cerium, cesium, chlorine, chromium, cobalt, copper, dysprosium, europium, gold, hafnium, iron, lanthanum, lead, lithium, lutetium, magnesium, manganese, molybdenum, nickel, niobium, potassium, rubidium, samarium, scandium, selenium, silver, sodium, strontium, tantalum, terbium, tin, titanium, tungsten, vanadium, ytterbium, zinc, and zirconium. Descriptions of field and analytical methods can be found in Appendix II-A. Sample locations are plotted on Plate I. All samples were analyzed for uranium by delayed neutron counting. Other elemental concentrations in samples were determined by neutron-activation analysis, x-ray fluorescence, and arc-source emission spectrography. Analytical results for samples are reported as parts per million.

28190 (GJBX—216-81) Detailed uranium geochemical stream sediment survey data release for selected portions of the Craig NTMS Quadrangle, Colorado, and Rawlins NTMS Quadrangle, Wyoming, including concentrations of forty-five additional elements. Shannon, S.S. Jr. (Los Alamos Scientific Lab., NM (USA)). Apr 1981. Contract W-7405-ENG-36. 172p. (LA—8481-MS). NTIS, PC A08/MF A01. Order Number DE81027984.

This detailed study was undertaken at the request of the NURE Program Office, Grand Junction, Colorado, to aid in the evaluation of the uranium potential of the Browns Park and North Park formations in the area east of the Maybell-Lay, Colorado, uranium district and southeast of the Baggs, Wyoming, uranium district. A total of 1199 stream sediment samples was collected from 1199 locations in five areas in the quadrangle. The areas are designated Spring Creek, Hahns Peak, Elkhead Mountains, Yampa, and White River. All samples were collected at a nominal density of one sample location per 1.4 km^2 Standardized field, analytical, and data base management procedures used during the sampling program are described briefly in the appendixes of this report. Elemental concentration, field measurement, weather, geologic, and geographic data for each sample location are listed in Appendix I. Uranium values range from 1.47 to 27.34 and have a mean of 3.53 ppM. Uranium/thorium ratios for sediment samples are also included in Appendix I. Sediments were analyzed for uranium and thorium as well as aluminum, antimony, arsenic, barium, beryllium, bismuth, cadmium, calcium, cerium, cesium, chlorine, chromium, cobalt, copper, dysprosium, europium, gold, hafnium, iron, lanthanum, lead, lithium, lutetium, magnesium, manganese, nickel, niobium, potassium, rubidium, samarium, scandium, selenium, silver, sodium, strontium, tantalum, terbium, tin, titanium, tungsten, vanadium, ytterbium, zinc, and zirconium (Appendix I). All sediments were analyzed for uranium by delayed neutron counting. Other elemental concentrations in sediments were determined by neutron activation analysis for 31 elements, by x-ray fluorescence for 12 elements, and by arc-source emission spectrography for 2 elements. Analytical results for sediments are reported as ppM.

28191 (GJBX—217(81)) Data release for intermediate-density hydrogeochemical and stream sediment sampling in the Vallecito Creek Special Study Area, Colorado, including concentrations of uranium and forty-six additional elements. Warren, R.G. (Los Alamos Scientific Lab., NM (USA)). Apr 1981. Contract W-7405-ENG-36. 100p. (LA—8483-MS). NTIS, PC A05/MF A01. Order Number DE81027983.

A sediment sample and two water samples were collected at each location about a kilometer apart from small tributary streams within the area. One of the two water samples collected at each location was filtered in the field and the other was not. Both samples were acidified to a pH of < 1; field data and uranium concentrations are listed first for the filtered sample (sample type = 07) and followed by the unfiltered sample (sample type = 27) for each location in Appendix I-A. Uranium concentrations are higher in unfiltered samples than in filtered samples for most locations. Measured uranium concentrations in control standards analyzed with the water samples are listed in Appendix II. All sediments were air dried and the fraction finer than 100 mesh was separated and analyzed for uranium and forty-six additional elements. Field data and

analytical results for each sediment sample are listed in Appendix I-B. Analytical procedures for both water and sediment samples are briefly described in Appendix III. Most bedrock units within the sampled area are of Precambrian age. Three Precambrian units are known or potential hosts for uranium deposits; the Trimble granite is associated with the recently discovered Florida Mountain vein deposit, the Uncompahgre formation hosts a vein-type occurrence in Elk Park near the contact with the Irving formation, and the Vallecito conglomerate has received some attention as a possible host for a quartz pebble conglomerate deposit. Nearly all sediment samples collected downslope from exposures of Timble granite (geologic unit symbol "T" in Appendix I) contain unusually high uranium concentrations. High uranium concentrations in sediment also occur for an individual sample location that has a geologic setting similar to the Elk Park occurrence and for a sample associated with the Vallecito conglomerate.

28192 **(GJBX—222-81) Hydrogeochemical and stream sediment reconnaissance basic data for Ketchikan Quadrangle, Alaska.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 29 May 1981. Contract W-7405-ENG-26. 109p. (K/UR—330). NTIS, PC A06/MF A01. Order Number DE81028764.

Field and laboratory data are presented for 751 water samples from the Ketchikan Quadrangle, Alaska. The samples were collected by Los Alamos National Laboratory; laboratory analysis and data reporting were performed by the Uranium Resource Evaluation Project at Oak Ridge, Tennessee.

28193 **(GJBX—11381) Field evaluation of active and passive direct uranium borehole logging systems.** Wilson, R.D.; Cosby, M.S.; Stone, J.M. (Bendix Field Engineering Corp., Grand Junction, CO (USA); Continental Oil Co., Falls City, TX (USA)). May 1980. Contract AC13-76GJ01664. 129p. NTIS, PC A07/MF A01. Order Number DE81028626.

Thirty test holes were placed in a variety of geologic environments and for wide variations in ore zone grade, thickness, and uranium/radium disequilibrium condition. The ore zones of each test hole were core drilled with >90% core recovery. Core samples were analyzed for a number of trace, minor and major elemental constituents, and for several physical properties. A standard suite of geophysical logs was obtained prior to casing the test holes. Direct uranium logs were then obtained by the PGT, Sandia, IRT, and Century Geophysical sondes. All core and logging results have been written to a computerized data base. The data base was then used to produce various comparison plots and other forms of data evaluation. Calculation of the grade-thickness product for each ore zone and sonde type shows that the logging results are widely dispersed about the values obtained from the core assays. Results for the IRT sonde are systematically lower than core results, the Century sonde severely overestimates the grade-thickness product for very low grade zones, and the PGT sonde exhibits a systematic trend toward underestimating grade-thickness for higher grade (>1000 ppM) ore zones. The Sandia sonde shows no such systematic trends and agrees well with core results at the higher grades (1000 to 2500 ppM range). Neglecting the very large discrepancies observed, for example, with Century's sonde at low grade, or with IRT's sonde when malfunction was suspected, the four direct uranium logging sondes exhibited similar dispersions about the core results.Approximately 50 percent of the time the logging sondes are within +-30% of the core results while about 75% of the time they are within +-50%. A certain amount of this dispersion is due to the unfavorable borehole conditions and to the variety of geologic environments sampled.

28194 **(LA—8484-MS) Uranium hydrogeochemical and stream sediment reconnaissance data release for the Red Creek quartzite special study area, Vernal NTMS Quadrangle, Utah/Colorado, including concentrations of forty-six additional elements.** Goff, S.; George, W.E.; Apel, C.T.; Hansel, J.M.; Fuka, M.A.; Bunker, M.E.; Hanks, D. (Los Alamos Scientific Lab., NM (USA)). Apr 1981. Contract W-7405-ENG-36. 33p. NTIS, PC A03/MF A01. Order Number DE81026796.

Totals of 22 water and 140 sediment samples were collected from 148 locations in the study area. The study area, in the north-central portion of the Vernal NTMS quadrangle, is covered by four 7-1/2' topographic maps: Dutch John, Goslin Mountain, and Clav Basin, Utah; and Willow Creek Butte, Utah/Colorado. Additional HSSR data are available for the entire Vernal quadrangle (Purson, 1980). All field and analytical data are presented in Appendix I. Figure 1 is an index and sample location map that can be used in conjunction with the 1:250,000-scale topographic map of the Vernal quadrangle (USGS, 1954). Standarized field, analytical, and data base management procedures were followed in all phases of the study. These procedures are described briefly in Appendix II-A and in reports by Sharp (1977), Hues et al (1977), Sharp and Aamodt (1978), Cheadle (1977), and Kosiewicz (1979). The data presented in Appendix I are available on magnetic tape from GJOIS Project, Union Carbide Corporation (UCC-ND), Computer Applications Department, 4500 North Building, Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, Tennessee 37830. Because this is simply a data release, intended to make the data available to the DOE and the public as quickly as possible, no discussion of the geology of the region, uranium occurrences, or data evaluation is included.

0505 Enrichment

REFER ALSO TO CITATION(S) 28214, 28214

28195 **(K/ET—5013(Add.1)) Calibration of a laminar flowmeter: the data and correlations.** Fain, D.E. (Oak Ridge National Lab., TN (USA)). May 1981. Contract W-7405-ENG-26. 35p. (CONF-810434—5(Add.1)). NTIS, PC A03/MF A01. Order Number DE81025227.

From 2. international symposium on flow; St Louis, MO, USA (6 Apr 1981).

Purpose of this addendum is to make available the actual data which were published in graphical form in K/ET-5013. In addition to the actual experimental data, the regression analyses and some additional graphic presentations are given.

28196 **(K/ET—5013(Rev.1)) Calibration of a laminar flometer.** Fain, D.E. (Oak Ridge National Lab., TN (USA)). Jan 1981. Contract W-7405-ENG-26. 19p. (CONF-810434—4(Rev.1)). NTIS, PC A02/MF A01. Order Number DE81024423.

From 2. international symposium on flow; St Louis, MO, USA (6 Apr 1981).

The accuracy and reproducibility of a flow device depends on two areas, one of which is a knowledge of the parameters needed to describe the flow rates through the device. This paper represents an effort to understand the parameters needed to describe the flow rate through a laminar flowmeter. Results indicate that better than 0.1% precision can be achieved for short periods (days). 7 figures. (DLC)

28197 **(K/ET—5014(Rev.2)) Portable transfer standards for pressure and gas flow measurements.** Fain, D.E.; Selby, T.W. (Oak Ridge National Lab., TN (USA)). Jan 1981. Contract W-7405-ENG-26. 27p. (CONF-810434—6(Rev.2)). NTIS, PC A03/MF A01. Order Number DE81024445.

From 2. international symposium on flow; St Louis, MO, USA (6 Apr 1981).

A system of portable transfer standards for both pressures and gas flow measurements has been developed to assure that different measurement systems at different locations are measuring relative to the same standards. The factors necessary to observe and control are discussed in addition to calibration procedures and operational results. The capability of maintaining a long term reproducibility of 0.1% for a flow system is demonstrated. A limited amount of data from a preliminary cross check shows agreement to better than 0.1% at the 95% confidence level. 15 figures.

28198 **(UCRL—85175(Rev.1)) Lasers in materials processing.** Davis, J.I.; Rockower, E.B. (Lawrence Livermore National Lab., CA (USA)). 1981. Contract W-7405-ENG-48. 44p. (CONF-810613—10(Rev.1)). NTIS, PC A03/MF A01. Order Number DE81027657.

From Conference on lasers and electro-optics; Washington, DC, USA (10 Jun 1981).

A status report on the uranium Laser Isotope Separation (LIS) Program at the Lawrence Livermore National Laboratory is

presented. Prior to this status report, process economic analysis is presented so as to understand how the unique properties of laser photons can be best utilized in the production of materials and components despite the high cost of laser energy. The characteristics of potential applications that are necessary for success are identified, and those factors that have up to now frustrated attempts to find commercially viable laser induced chemical and physical process for the production of new or existing materials are pointed out.

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 28657

28199 **(GA-A—16215) Characterization of defective SiC coatings in TRISO HTGR fuel particles.** Kovacs, W.J. (General Atomic Co., San Diego, CA (USA)). Apr 1981. Contract AT03-76ET35300. 22p. (CONF-810528—8). NTIS, PC A02/MF A01. Order Number DE81026582.

From 83. symposium on nucleation and crystallization in glasses; Washington, DC, USA (3 May 1981).

Defective SiC layers in TRISO coated fissile fuel irradiated in capsules GF-1, GF-2, GF-3, and SSL-1 were evaluated by utilizing burn-leach and mercury intrusion/radiographic techniques. The recently developed mercury intrusion/radiographic technique is more conservative than the burn-leach technique for measuring the level of defective SiC layers. Gaseous fission produce release during irradiation can be predicted more accurately by calculating total coating failure (f/sub T/) as f/sub T/ = f_0 x f/sub SiC/, where f_0 is the expected OPyC failure during irradiation and f/sub SiC/ is the fraction defective SiC layers determined by the mercury intrusion/radiographic technique. The high OPyC failure (up to 61%) observed in GF-1, -2, and -3 and SSL-1 was a result of out-of-specification OPyC properties. Current specification requirements assure ≦ 1% OPyC failure; thus underestimating the SiC defect fraction by use of the burn-leach technique has a minor impact on gaseous release. Metallic release is not a performance limit based on circulating activity levels. Future HTGRs are being designed for higher operating temperatures and hands-on maintenance capability. These conditions will result in metallic release becoming more limiting with a corresponding emphasis on a more accurate measurement such as the mercury intrusion/radiographic technique of the fraction defective SiC layers.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 28217, 28225, 28226, 28228, 28232, 28233, 28234, 28235, 28236, 28237, 28250, 28254, 28257, 28326, 28328, 28330, 28333, 29214

28200 (CONF-801038—(Vol.1), pp 745-762) **Performance of sand filters for the separations areas at the Savannah River Laboratory.** Orth, D.A.; Sykes, G.H.; McKibben, J.M. (E.I. du Pont de Nemours and Co., Aiken, SC). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Two new large sand filters, 30.5 by 100 m, were constructed and put into service at the Savannah River Plant (SRP) in 1975 and 1976. These units were designed to provide final filtration of process air - one for each of the two separations areas. Eventual flow will be 4950 m^3/min (205,000 scfm) on each unit when all facilities are connected. They were built as replacements for the original sand filters that began operation in 1954 and 1955. The new filters have been operated in parallel with the old units following partial failure of the old units from acid attack and erosion of the concrete support structure for the sand beds. The design of the new units was based on extensive tests at SRP on characteristics of different sands. The performance of the new filters meets criteria for pressure drop, flow capacity, and efficiency. The efficiencies measured by DOP test are greater than 99.98%. Parallel operation reduces air velocity through the beds, which increases efficiency. A characteristic of sand filter performance has been low apparent efficiency at low input; efficiency increases as the activity input rises. This is attributed to a small entrainment release from the large amount of activity already sorbed on the filter; this release controls and lowers the calculated efficiency at low input. An analysis of efficiency as a function of input activity projects efficiencies greater than 99.99% for large inputs that might be characteristic of large internal accidents. The data indicate that DOP efficiencies can be used in hazards analyses to determine accident consequences. Routine evaluation of filter releases can be used for surveillance to establish that performance is normal at other times.

28201 (CONF-801038—(Vol.2), pp 1420-1424) **Review of work carried out 1978 to 1980 on HEPA filters and ventilation systems at the Dounreay site of the UKAEA.** Lillyman, E. (UKAEA Dounreay Nuclear Establishment, Caithness, Scotland). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

This review covers work in the past 2 years on ventilation system design on new active plants and buildings, improved HEPA filter housings and HEPA filter modifications to assist in disposal. Further work has commenced on leak rates through building materials.

28202 **(CONF-810706—21) Nondestructive assay of spent boiling water reactor fuel by active neutron interrogation.** Blakeman, E.D.; Ricker, C.W.; Ragan, G.L.; Difilippo, F.C.; Slaughter, G.G. (Tennessee Univ., Knoxville (USA); Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 8p. NTIS, PC A02/MF A01. Order Number DE81026326.

From Institute of Nuclear Materials Management conference; San Francisco, CA, USA (13 Jul 1981).

Spent boiling water reactor (BWR) fuel from Dresden I was assayed for total fissile mass, using the active neutron interrogation method. The nondestructive assay (NDA) system used has four Sb-Be sources for interrogation of the fuels; the induced fission neutrons from the fuel are counted by four lead-shielded methane-filled proportional counters biased above the energy of the source neutrons. Spent fuel rods containing 9 kg of heavy metal were chopped into 5-cm segments and loaded into three 1-liter cans. The three cans were assayed in seven combinations of one, two, or three cans, enabling an evaluation of the precision and accuracy of the NDA system for different amounts of fissile material. The fissile mass in each combination was determined by comparing the induced-fission-neutron counts with the counts obtained from a known standard comprising chopped segments of unirradiated Dresden fuel. These masses were compared to the masses determined by chemical analyses of the spent fuel. The results from the nondestructive assays agreed with results from the chemical analyses to within 2 to 3%. Similar agreement was obtained when two combinations of canned spent fuel were used as standards for the nondesctuctive assays. The assay of BWR spent fuel served as a test of the NDA system which was developed at the Oak Ridge National Laboratory for the assay of spent liquid metal fast breeder reactor (LMFBR) fuel subassemblies at the heat-end of a reprocessing plant. Results of previous experiments and calculations reported earlier using simulated LMFBR fuel subassemblies indicated that the NDA system can measure the fissile masses of spent fuel subassemblies to within an accuracy of 3%. Results of the assays of spent BWR fuel reported herein support this conclusion.

28203 **(ENICO—1078) Third electrolytic dissolution campaign of EBR-II fuel at ICPP.** Mortimer, S.R. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). Jun 1981. Contract AC07-79ID01675. 48p. NTIS, PC A03/MF A01. Order Number DE81027672.

The third electrolytic dissolution campaign was completed during 1977 at the Idaho Chemical Processing Plant. A total of 238 Kg of ^{235}U from EBR-II fuel was processed. Operating problems, conditions, and types of fuels are discussed.

28204 **(GA-C—16172/11-30-80) Consolidated fuel-reprocessing program. Quarterly progress report for the period ending November 30, 1980.** (General Atomic Co., San Diego, CA (USA)). Dec 1980. Contract AT03-76SF71053. 30p. NTIS, PC A03/MF A01.

Large-scale crushing and burning tests of fuel received from the Federal Republic of Germany (FRG) have identified differ-

ences in processing characteristics. The NO/sub x/ converter experimental tests continued this quarter in the GA off-gas system. The dependence of nitric oxide conversion efficiency on ammonia and oxygen concentrations has been determined. An optimum ratio of ammonia to nitric oxide was identified in terms of the conversion factor for nitrix oxide. No residual ammonia was detected downstream of the NO/sub x/ converter. Design of the radon source subsystem and fabrication of the radon source assembly and shielded radon source containment were completed. Second-thorium-cycle column tests confirm the feasibility of producing thorium product having acceptably low uranium contents. Two axial mixing tests were completed on the thorium extraction section. The Mott inertial filter tests continued. The dissolution rate of HTGR fuel spheres is speeded by a factor of three by using an airlift acid recirculator to improve ThO_2-dissolvent contact. The FRG HTGR fuel spheres dissolve a factor of three more slowly than the sol-gel derived ThO_2 spheres. The task group completed a thorium transfer kinetics comparison of alternative solvents. Hydrolysis studies were started on alternative solvents.

28205 **(HEDL-TME—80-83) Pre-test nondestructive examination data summary report on Turkey Point spent fuel assemblies D01, D04 and D06 for the climax-spent fuel test.** Davis, R.B. (Hanford Engineering Development Lab., Richland, WA (USA)). Jan 1981. Contract AC14-76FF02170. 161p. NTIS, PC A08/MF A01. Order Number DE81026799.

Fuel assembly sip testing conducted at Turkey Point and Battelle Columbus Laboratories (BCL) confirmed no leaking rods were among the thirteen fuel assemblies included in the Climax-Spent Fuel Test. A detailed nondestructive examination was conducted on three of the thirteen assemblies. Fuel assembly lengths and widths averaged 153.6 inches and 8.3 inches, respectively. The assemblies weighed 1459 +- 3 lbs. Total neutron flux measured at the fuel column midplane was 1.06 x 10^4 N/cm²/s with an average neutron energy of 1.4 MeV. Gamma dose rates were measured axially and vertically to the fuel column with maximum contact dose rate of 9.52 x 10^4 R/h. Twenty rods underwent detailed rod nondestructive examination. Rod lengths and weights averaged 152.5 inches and 6.82 lb, respectively. Spiral profilometry scans showed the maximum ovality for the twenty rods was 0.0105 inch with average rod diameters ranging from 0.4201 inch to 0.4211 inch. Extensive ridging from pellet cladding interaction was evident over most of the length on all rods. Gamma scan results showed no cesium peaking and no unusually large pellet to pellet gaps. Approximate 10% gamma activity depressions were found at the grid spacer locations. Several areas were identified as locations with an internal anomaly using eddy current results. Fifteen rods were reinserted into the three fuel assemblies at the completion of the nondestructive examinations. Five rods remained at BCL for destructive characterization.

28206 **(ORNL—5733) Gas phase dispersion in a small rotary kiln.** Spencer, B.B. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 186p. NTIS, PC A09/MF A01. Order Number DE81027065.

Thesis.

A study was made of nonideal flow of gas in a rotary kiln reactor. A rotating tube 0.165 m in diameter by 2.17 m long, with internal lifting flights, was operated at room temperature. Rotational speeds from 2.0 to 7.0 rpm, air flow rates from 0.351 to 4.178 m³/h, and solid contents of 0.0, 5.1, and 15.3% of tube volume were studied. Residence time distribution of the gas was measured by means of the pulse injection technique using a helium tracer. A model was developed based on dispersive flow that exchanges with a deadwater region. Two parameters, a dispersion number describing bulk gas flow and an interchange factor describing exchange between the flow region and the gas trapped in the solids bed, were sufficient to correlate the data, but these parameters are sensitive to experimental error. The model is applicable to analysis of other flow systems, such as packed beds.

28207 **(ORNL/TM—7686) Adjoint gamma ray estimation to the surface of a cylinder: analysis of a remote reprocessng facility.** Cramer, S.N. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 32p. NTIS, PC A03/MF A01. Order Number DE81027673.

The next event estimator in the MORSE multigroup Monte Carlo code has been extended to include Klein-Nishina scattering and annihilation radiation from pair production for both the forward and adjoint modes of calculation. A formulation for the solid angle subtended at a point by a cylinder has also been used in the estimator. These procedures have been included in the investigation of the gamma ray environment in the design of a remote fuel reprocessing facility. Calculational results are presented which indicate the validity and efficiency of the developed methods as compared to those in standard use.

28208 **(RHO-SA—223) Systems engineering approach to preconceptual design.** (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). 1981. Contract AC06-77RL01030. 14p. (CONF-8106124—1). NTIS, PC A02/MF A01. Order Number DE81026245.

From Civil engineering department seminar; Seattle, WA, USA (1 Jun 1981).

Steps in the typical pre-conceptual engineering study are: problem identification, identify alternatives, evaluate alternatives, and recommend solution. Three examples of the use of pre-conceptual approach to save money are given; they include the water supply for fire protection in the 200-West Area of Hanford, emergency power for the Purex plant, and new filter for the Purex plant canyon exhaust. (DLC)

0509 Transport And Storage

REFER ALSO TO CITATION(S) 28283, 28284, 28285, 28286, 28287, 28288, 28302

28209 **(HEDL-SA—2325-FP) Zircaloy cladding: Tough Containment for Spent Fuel Storage.** Einziger, R.E.; Bosi, D.M.; Miller, A.K. (Hanford Engineering Development Lab., Richland, WA (USA); Westinghouse Hanford Co., Richland, WA (USA); Stanford Univ., CA (USA)). 1981. Contract AC14-76FF02170. 7p. (CONF-810606—57). NTIS, PC A02/MF A01. Order Number DE81024105.

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

The present work leads us to strongly believe that if the cladding temperature is held below 425°C then the cladding provides a significant barrier against radionuclide migration for over 1000 years. Unless some alternative benefit is identified, we feel that steps should be taken to preserve the integrity of the Zircaloy cladding - Tough Containment for Spent Fuel Storage.

28210 **(RAND/R—2558-DOE) Away-from-reactor storage of spent nuclear fuel: factors affecting demand.** Dinneen, P.M.; Solomon, K.A.; Triplett, M.B. (RAND Corp., Santa Monica, CA (USA)). Oct 1980. Contract AC01-79PE70078. 173p. NTIS, PC A08/MF A01. Order Number DE81026982.

This report analyzes factors that affect the magnitude and timing of demand for government AFRs, relative to the demand for other storage options, to assist policymakers in predicting this demand. Past predictions of AFT demand range widely and often appear to conflict. This report helps to explain the apparent conflicts among existing demand predictions by demonstrating their sensitivity to changes in key assumptions. Specifically, the report analyzes factors affecting the demand for government AFR storage facilities; illustrates why demand estimates may vary; and identifies actions that may be undertaken by groups, within and outside the government, to influence the level and timing of demands.

28211 **(RFP—3241) Evaluation of a tri-wall corrugated fibreboard package for packaging and transporting LSA nonretrievable waste.** Saiki, D.M.; Aguilar, P.G. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1981. Contract AC04-76DP03533. 41p. NTIS, PC A03/MF A01. Order Number DE81027216.

An evaluation was conducted to determine if an economical Tri-Wall Corrugated Fiberboard (TWCF) Package could be used for transporting LSA nonretrievable wastes (< 10 nCi/g radioactive contamination). A complete description of the packaging configuration was given. The evaluation included Vibration Tests to

determine if the TWCF Package would comply with the present DOT regulation for packaging LSA waste (i.e. the package must be a strong-tight package that will not leak material under conditions normally incident to transport). Presently, no specific tests are required to determine compliance. Additional tests were conducted to determine performance of the package under selected adverse and hypothetical accidental conditions. No significant damage or loss of waste material occurred during the Vibration Tests thus indicating compliance with the present DOT regulation. The other performance tests indicated that some loss of waste material would occur under certain accidental conditions, however, the loss would be minimal. As a result of these performance tests, certain operating limitations and precautions regarding the handling and use of the package were given. Since the TWCF Package appears to meet DOT regulations and performed favorably under certain selected adverse and hypothetical accidential conditions, it was recommended for use in transporting certain types and forms of LSA nonretrievable wastes.

28212 (SAND—79-2101) Transportation technology quick reference file. Shepherd, E.W. (ed.). (Sandia National Labs., Albuquerque, NM (USA)). May 1981. Contract AC04-76DP00789. 65p. NTIS, PC A04/MF A01. Order Number DE81026469.

This publication is a collection of items written by different authors on subjects relating to the transportation of radioactive materials. The purpose of the document is to meet the continuing need for information on specific subjects for dissemination to the public at their request. The subjects included were selected on the basis of the questions most often asked about radioactive materials and their transportation. Additional subjects are being considered and will be included in the future. The loose-leaf notebook format is used to facilitate the updating of this material. The data used in many of the papers represent the best available at time of publication and will be updated as more current information becomes available.

0510 Marketing And Economics

28213 (DOE/NE—0013) Survey of United States uranium marketing activity. Krusiewski, S.V.; Thomas, D.C.; Patterson, J.A. (Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy). Jun 1981. 34p. NTIS, PC A03/MF A01. Order Number DE81027690.

In 1980 US buyers contracted for 12,500 short tons U_3O_8 in new procurement. Nontheless, there was a net decrease of 13,100 tons in total commitments as of January 1, 1981, because of even larger changes to the delivery commitments as of January 1, 1980. The average contract price of domestic uranium was $28.15 per pound of U_3O_8 for 1980 delivery and $30.70 for 1981 delivery. Settlements of domestic market price contracts averaged $36.75 for 1980 delivery and $46.80 for 1981 delivery. Prices of foreign uranium averaged $43.10 for 1980 delivery and $40.00 for 1981 delivery. Producers expect to be able to offer 21,800 tons U_3O_8 for sale in the 1981 to 1985 period, about 30 percent less than was estimated in the 1980 survey. US producers also estimated that 30,600 tons U_3O_8 would be available for sale in the 1986 to 1990 period. Utilities made sales of 800 tons U_3O_8 for 1980 to 1981 delivery as well as loans of another 800 tons. New export commitments made in 1980 totalled 4000 tons U_3O_8; however, 2500 tons of these commitments are options or delivery is contingent on price developments. Import commitments made in 1980 totalled 2300 tons U_3O_8. Inventories of natural and enriched uranium held by US buyers increased from 52,300 to 63,400 tons U_3O_8 during 1980. In addition, inventories of uranium held by US producers increased from 2400 to 2700 tons U_3O_8. Unfilled requirements for the 1981 to 1990 period decreased from 75,300 tons U_3O_8, as reported in last year's survey, to 54,500 tons in this year's survey, a decrease of 20,800 tons. Responses to the 1981 survey suggest that there seems to be an adequate supply of uranium to meet US demand at least through 1986, although the apparent buyer requirements reported as of January 1, 1981 for the 1987 to 1990 period are higher than the total domestic production or supply.

28214 (ORO—822) Uranium enrichment. 1980 annual report. (USDOE Assistant Secretary for Nuclear Energy, Washington, DC. Office of Uranium Enrichment and Assessments). May 1981. 34p. NTIS, PC A03/MF A01. Order Number DE81026350.

This report contains data and related information on the production of enriched uranium at the gaseous diffusion plants and an update on the construction and project control center for the gas centrifuge plant. Power usage at the gaseous diffusion plants is illustrated. The report contains several glossy color pictures of the plants and processes described. In addition to gaseous diffusion and the centrifuge process, three advanced isotope separation process are now being developed. The business operation of the enrichment plants is described; charts on revenue, balance sheets, and income statements are included. (DMC)

0520 Waste Management

REFER ALSO TO CITATION(S) 28087, 28200, 28201, 28209, 28325, 28701, 28702, 28703, 28704, 28705, 28706, 28707, 28723, 28774, 28775, 29081, 29104, 29133, 29214, 29230, 29251, 29369, 29372, 29373, 29733

28215 (ORNL-tr—4758) Storage and solidification of MAW and LAW in underground cavities. [Semiannual report], January 1, 1979-June 30, 1979. Uerpmann, E.P. (Oak Ridge National Lab., TN (USA)). [nd]. Translation source information not available . 3p. NTIS, PC A02/MF A01. Order Number DE81028712.

On the 490 m floor of the Asse salt mine, former temperature test floor 2 was prepared for leaching experiments. The floor was given the form of a trough and was then provided with decontaminable coating so that in case of a possible leak of the contaminated liquid from 40 leaching containers, the rest of the mine would not be harmed. To determine the leaching rates, the samples were placed in containers filled with various leaching liquids. The leaching of the nitrate contained in the samples was then measured by sampling and testing at various levels. For the purpose of examining leaching of the Cs nuclide, which is the most interesting among the MAW components, further experiments were prepared. After 28 days of storage under standard atmosphere conditions, the blocks were placed in the experimental area of the 490 m floor in various liquids. Because in this case only inactive $CsNO_3$ was added, the sensitive evaluation method with the gamma spectrometer had to be abandoned and the atomic absorption procedure had to be used instead.

28216 Impact of a high-level nuclear waste repository on the regional ground-water flow. Runchal, A. (Analytic and Computational Research, Inc., Los Angeles, CA); Maini, T. Contract W-7405-ENG-26. *International Journal of Rock Mechanics and Mining Sciences and Geomechanics Abstracts ;* **17**: No. 5, 253-264(Oct 1980).

Of all the alternatives suggested for the disposal of the high level nuclear waste, that of the deep underground burial in geologic formations may prove to be the most attractive. Within the constraints of economy and feasibility, the primary concern in deep underground burial is the selection of a geologic formation that will contain and isolate the wastes so that radioactive nuclides from the waste do not enter the biosphere in amounts that will endanger public health and safety. It is recognized that the primary mechanism for the likely introduction of the radioactive elements into the biosphere is that of ground water transport. It is thus imperative that the effect of nuclear waste disposal repository on ground water flow be fully explored and understood. This paper examines: (1) the problem of defining reliable hydrogeological properties of a rock mass, (2) the prediction of thermally induced ground flow on a regional scale for a crystalline rock formation. It is concluded that in the absence of major geologic discontinuities the deep disposal of radioactive waste may be technically feasible. However, the need for further field and theoretical studies is highlighted by the paucity of reliable data and the inadequacies of existing methodologies.

28217 (CONF-801038—(Vol.1)) **16th DOE nuclear air cleaning conference: proceedings.** First, M.W. (ed.). (Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab.). Feb 1981. 857p. NTIS, PC A99/MF A01. Order Number DE81026619.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Major topics discussed during the Sixteenth DOE Nuclear Air Cleaning Conference were: waste treatment, including volume reduction and storage; system and component response to stress and accident conditions; Three Mile Island accident; iodine adsorption; treatment and storage of noble gas; treatment of offgases from chemical processing; aerosol behavior; containment venting; laboratory and in-place filter-testing methods; and particulate filtration. Volume I of the Proceedings has 49 papers from the following sessions: HEPA filter test methods; noble gas separation; air cleaning system design; containment venting; iodine adsorption; reprocessing offgas cleaning; critical review; filtration, filter testing, and aerosols. Volume II contains 44 papers from the sessions on: nuclear waste treatment; critical review; noble gas treatment; carbon-14 and tritium; air cleaning system response to stress; nuclear standards and safety; round table; open end; and air cleaning technology at Three Mile Island. Abstracts are provided for all of these papers.

28218 (CONF-801038—(Vol.1), pp 17-34) **In situ measurement of the efficiency of filtration installations in the nuclear industry by the soda-fluorescein (uranin) aerosol method: AFNOR standard NFX 44.011.** Dupoux, J. (Centre d'Etudes Nucleaires de Saclay, France). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

The in situ measurement of the efficiency of filtering installations in the French nuclear industry using the soda-fluorescein (uraniun) aerosol method is presented. A brief description and the interest of the method are discussed. Its use for the location of defects in filter elements and for in situ control of casing with tandem HEPA filter stages is described.

28219 (CONF-801038—(Vol.1), pp 35-55) **Comparative study of in-situ filter test methods.** Marshall, M.; Stevens, D.C. (AERE, Harwell, England). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Available methods of testing high efficiency particulate aerosol (HEPA) filters in-situ have been reviewed. In order to understand the relationship between the results produced by different methods a selection has been compared. Various pieces of equipment for generating and detecting aerosols have been tested and their suitability assessed. Condensation-nuclei, DOP (di-octyl phthalate) and sodium-flame in-situ filter test methods have been studied, using the 500 cfm (9000 m^3/h) filter test rig at Harwell and in the field. Both the sodium-flame and DOP methods measure the penetration through leaks and filter material. However the measured penetration through filtered leaks depends on the aerosol size distribution and the detection method. Condensation-nuclei test methods can only be used to measure unfiltered leaks since condensation nuclei have a very low penetration through filtered leaks. A combination of methods would enable filtered and unfiltered leaks to be measured. A condensation-nucleus counter using n-butyl alcohol as the working fluid has the advantage of being able to detect any particle up to 1 μm in diameter, including DOP, and so could be used for this purpose. A single-particle counter has not been satisfactory because of interference from particles leaking into systems under extract, particularly downstream of filters, and because the concentration of the input aerosol has to be severely limited. The sodium-flame method requires a skilled operator and may cause safety and corrosion problems. The DOP method using a total light scattering detector has so far been the most satisfactory. It is fairly easy to use, measures reasonably low values of penetration and gives rapid results. DOP has had no adverse effect on HEPA filters over a long series of tests.

28220 (CONF-801038—(Vol.1), pp 56-66) **Comparison of methods for particulate testing of HEPA filters.** Dorman, R.G. Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

In 1976 a suggestion was made at a European Economic Community Seminar in Aix-en-Provence that there should be an attempt to correlate results of the various methods of testing HEPA filters. From previous results with the Q127 DOP equipment there seemed to be a reasonable correlation with the sodium chloride test employed in the United Kingdom when sheets of 100 cm^2 were tested, while a few tests with HEPA filters also showed fair agreement with figures from the British Standard 3928 method. Little, however, was known of comparisons with other methods when intact HEPA filters were tested. An investigation, begun under an EEC contract in 1979, included as its object both rig and on-site assessments at various European Establishments. Transport of large filters leads to damage of unknown magnitude, whilst seating into test ducts may not always be perfect; on the other hand, testing the same filter many times may lead to erroneous comparisons due to clogging. In consequence in the work, which has continued in 1980, a large number of sheets of 100 cm^2 area, held in a leak-proof jig, has also been employed. Some 140 sheets of each of five grades of filter paper were obtained. Tests on randomly chosen sheets indicated consistent penetration figures (variation within any grade less than 15%) so that there were good grounds for assuming that the filters were suitable for comparison purposes. Ten different methods of rig and on-site tests have been investigated, with results reported in this paper. As expected, there are wide differences in absolute penetrations, in velocity/pnentration curves and in sensitivity. Figures for penetration of the paper sheets are still awaited from the ten other test houses and a detailed analysis will not be attempted until these have been received.

28221 (CONF-801038—(Vol.1), pp 104-108) **Report of minutes of government-industry meeting on filters, media, and media testing.** Anderson, W.L. (Naval Surface Weapons Center, Dahlgren, VA). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

This session, following the precedents of earlier meetings, related the operating requirements placed on the high efficiency filter and the capacity of industry to meet them. To this end, the collected talents of the assembled body were unified toward the problems of the particulate filter, its components, and its methods of test. The following seven subjects were discussed: round robin paper test program; DOP (di-octyl phthalate) carcinogenicity; DOP substitute (thermal); DOP substitute (air); filter materials in corrosive environments; fire retardant filter frames; and filter unit leakage. Highlights of the session are: results of the round robin filter exchange test program to ascertain the accuracy and reproducibility of the Q127 filter media tester indicated that the overall agreement between the widely dispersed instruments were much better than expected and previously determined; the National Cancer Institute (NCI) is expected to issue in the near future an intelligence bulletin, pointing out that some carcinogenic effect was noted of DOP from bioassay data; it was recommended that polyethylene glycol 400 be accepted as a substitute for DOP in thermal generators; for the Laskin-type air-operated generators, dioctyl sebacate appeared to give the most promising results; a strong recommendation was made that all polyurethane foams be excluded from specifications and use where the filter unit will be exposed to acid environments; filter unit leakage was attributed to a lack of or insufficient adhasive and/or improper application of adhesie.

28222 (CONF-801038—(Vol.1), pp 109-124) **Selected polyethylene glycols as DOP substitutes. Addendum 1.** Gerber, B.V. (US Army ARRADCOM Chemical Systems Lab., Aberdeen Proving Ground, MD). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

The recommendation is made that Polyethylene glycol (PEG) 400 be considered as a substitute for DOP in aerosol generators producing a polydisperse distribution for testing the integrity of filters and for testing respirator fit. Further, the recommendation is made that pentaethylene glycol (PTAEG) and possibly hexaethylene glycol be considered as a substitute for DOP in aerosol generators thermally producing monodisperse aerosol for quality acceptance tests according tu US federal specifications and standards. The

toxicology data base available on the polyethylene glycol family of chemical compounds is discussed and the conclusion is drawn that the probability of approval and acceptance as a non-hazardous substance in the filter and filter media test role is high. Data and analysis supporting PTAEG performance equivalent to DOP in the filter and filter media test role are given or referenced. Cost and availability of the substitute materials is discussed. Conclusions based on the present data and information are given and recommendations for further work are made.

28223 (CONF-801038—(Vol.1), pp 141-160) **Review of the adsorption of radioactive krypton and xenon on activated charcoal.** Underhill, D.W. (Univ. of Pittsburgh, PA); Moeller, D.W. Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

This report summarizes the results of a critical review of the published literature on the adsorption of radioactive krypton and xenon on activated charcoal. This review, which was supported by the Advisory Committee on Reactor Safeguards, US Nuclear Regulatory Commission, showed that (a) individual charcoals have a wide range of adsoprtion coefficients and therefore the performance of a given bed is heavily dependent on the quality of the charcoal it contains; (b) because of the detrimental effects of mass transfer on noble gas adsorption, consideration should be given to including this factor in developing technical specifications for adsorption beds; and (c) additional research is needed on the determination of the inter-relationship of moisture and temperature and their effects on adsorption bed performance.

28224 (CONF-801038—(Vol.1), pp 161-176) **Noble gas separation from nuclear reactor effluents using selective adsorption with inorganic adsorbents.** Pence, D.T.; Paplawsky, W.J. (Science Applications, Inc., San Diego, CA). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

A radioactive waste gas treatment system utilizing selective adsorption on inorganic adsorbents is described for application to PWRs. The system operates at near ambient pressure, does not require a hydrogen recombiner, has low radioactive gas inventories, and is cost competitive with existing treatment systems. The proposed technique is also applicable for recovery of noble gases from the containment building of a nuclear reactor after an accident. A system design for this application is also presented.

28225 (CONF-801038—(Vol.1), pp 177-201) **Removal of Kr from N_2 by selective adsorption.** Ruthven, D.M. (Univ. of New Brunswick, Fredericton); Devgun, J.S.; Tezel, F.H.; Sridhar, T.S. Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

The results of a chromatographic study of the sorption kinetics and equilibria for N_2 and Kr on several zeolitic adsorbents are presented. Of the adsorbents investigated the most promising for selective removal of Kr from the off-gas of nuclear fuel processing facilities is H-mordenite. It is shown that the selectivity of this adsorbent towards Kr may be increased by de-alumination and at low temperatures the selectivity of the de-aluminated mordenite becomes comparable with that of the best activated carbon adsorbents.

28226 (CONF-801038—(Vol.1), pp 202-213) **Steady state operation of the first cryogenic column in a krypton separation system.** von Ammon, R.; Bumiller, W.; Hutter, E.; Neffe, G. (Kernforschungszentrum Karlsruhe, Germany). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Recent results obtained during the operation of the inactive test unit KRETA for the cryogenic separation of krypton from simulated reprocessing off-gases are presented. The first rectification column of this unit was modified by shortening its lower part from 18 to 8 practical plates and placing the feed point into the warmer, krypton-rich section. Two essential results were thus achieved: plugging by desubliming xenon was not observed even at xenon feed concentrations as high as 1 vol.-%; and, accumulation of oxygen was much lower than in the column version used previously, thus reducing the potential hazard by ozone formation drastically. The accumulation of methane, however, was found to be high, in agreement with calculations.

28227 (CONF-801038—(Vol.1), pp 216-224) **Safety evaluation of large ventilation networks.** Barrocas, M.; Pruchon, P.; Robin, J.P.; Rouyer, J.L.; Salmon, P. Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

For large ventilation networks, it is necessary to make a safety evaluation of their responses to perturbations such as blower failure, unexpected transfers, local pressurization. This evaluation is not easy to perform because of the many interrelationships between the different parts of the networks, interrelationships coming from the circulations of workers and matetials between cells and rooms and from the usefulness of air transfers through zones of different classifications. This evaluation is all the more necessary since new imperatives in energy savings push for minimizing the air flows, which tends to render the network more sensitive to perturbations. A program to evaluate safety has been developed by the Service de Protection Technique in cooperation with operators and designers of big nuclear facilities and the first applications presented here show the weak points of the installation studied from the safety view point.

28228 (CONF-801038—(Vol.1), pp 317-333) **Selected solutions and design features from the design of remotely handled filters and the technology of remote filter handling. Previous operating experience with these components in the PASSAT facility.** Jannakos, K.; Lange, W.; Potgeter, G.; Furrer, J.; Wilhelm, J.G. (Kernforschungszentrum Karlsruhe, Germany). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

In a prototype filter offgas cleaning system for reprocessing plants (PASSAT) built at the Karlsruhe Nuclear Research Center a fullscale filter cell with remotely handled filters for aerosol and iodine removal and the corresponding remote handling systems for exchange, bagging out, packaging and disposal of spent filter elements has been installed and run in trial operation since July 1978. The filters and the replacement techniques have been tested for the past two years or so and so far have always worked satisfactory over the test period involving some 150 replacement events. Neither wear nor corrosion phenomena were found in the filter housings and the replacement systems. The seals and clamping devices were selected so that during operation the prescribed leak rates of $< 10^{-3}$ Torr l/s were always maintained on the filter lid, the seat of the filter element and the cell lock. The total clamping loads for the filter element and the filter lid amount to $\sim$ 20 kN. The force necessary to separate the filter element from the filter housing is $\sim$ 3.5 kN. No ruptures of seals or gaskets were to be detected. The design of the filters and of the handling systems has been found satisfactorily in the cold test operation so far and can be recommended for use in nuclear facilities. In all experiments conducted until now PASSAT has worked without any failure. All operating data required in the specifications were met in the test period. The maximum pressure loss in the system with loaded filter elements amounts to some 3000 mm of water. After operation with iodine and NO/sub x/, plant components exposed to 100% relative humidity and condensate showed corrosion.

28229 (CONF-801038—(Vol.1), pp 437-447) **Activated charcoal filters and the test canisters.** Hayn, P.W.; Stiehl, H.H.; Mathewes, W. Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Activated carbon filters are used with success for adsorption of radioactive fission products in nuclear power stations. The designs known hitherto utilize the activated carbon with varying efficiency. New filter designs give good results of efficiency of the carbon used; a reduction of waste volume is possible compared to older filter designs. Good utilization of the loading capacity of the activated carbon can only be reached by close supervision and determination of its loading condition. The test adsorbers arranged in parallel and used on deep bed filters cannot be used for the fluid-

ized bed carbon filter; on the latter carbon is sampled from the main filter for testing purpose by means of a spindel. Safest adsorption of radioactive fission products is realized by using deep bed filters as on these poisoning phenomena of the activated carbon on the efficiency have little influence only.

28230 (CONF-801038—(Vol.1), pp 487-503) **Pre-accident weathering of impregnated carbons for iodine removal.** Deitz, V.R. (Naval Research Lab., Washington, DC). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

The atmospheric degradation of carbons, measured by increased penetration of methyl iodide-131, is an important factor in the operation and replacement of carbon filters. The commercial carbons are distinguished by three types of impregnations: (1) KI + xI_2, (2) KI and a tertiary amine, and (3) the tertiary amine alone. A degradation of these carbons has been observed in continuous flows of outdoor air and this degradation has been found to decrease in the sequence (1) to (2) to (3) over exposure times of up to one year. It is concluded that the choice of impregnation formulation in nuclear-grade carbons is an important factor towards high efficiency and long service life. The pattern of air contaminants observed in the above weathering at several locations was subject to considerable fluctuation. The atmospheric conditions, particularly relative humidity and dew point, are important factors when these are in a range in which the relative humidity is above 50%. The seasonal effect has been observed for monthly exposures of KI/sub x/ carbons. Weathering under laboratory conditions suggests that the expected life (24 to 30 months) of the carbon might be realized if only the normal contaminants of the air alone were present. In air flows above 50% RH, and when accidental solvent spills occur, the combined effect with the contaminants accelerates the degradation of the carbons. A determination of iodine-131 penetration is obviously the decisive factor in safety performance. The test results provide a valid indication of the condition of the carbon at the time of the test and if the carbon proves to be unacceptable, the filter system has already operated for a period of time with degraded carbon. It is recommended that some on-line measurement be made that would anticipate a drastic drop in trapping efficiency. A routine in-line chromatographic test procedure with methyl iodide-127 may be one possibility.

28231 (CONF-801038—(Vol.1), pp 531-536) **Modified TEDA impregnants for methyl iodine removal.** Underhill, D.W. (Univ. of Pittsburgh, PA); Laskie, J.R. Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

One of the more successful impregnants for methyl iodide removal has been TEDA (Triethylene Diamine). The high activity of this compound owes as much to its rigid structure as to its basicity. Drawbacks to the use of TEDA as an impregnant have been (1) its vapor pressure and (2) that it is a solid and must be dissolved in water before applying to the charcoal. It is reported that the addition of C-Alkyl groups to the TEDA molecule can serve the purpose of decreasing the vapor pressure of the TEDA molecule. Thus improved performance at higher temperatures is expected when such modified TEDA compounds are used. Charcoals impregnated with C-Alkyl derivatives of TEDA are capable of retentions of more than 99% of the input methyl iodide under standard test conditions at 130°C, 95% R.H. Repeated tests of such charcoals have shown their ability, under standard test conditions, to retain greater than 99% methyl iodide at 25°C, 95% R.H.

28232 (CONF-801038—(Vol.1), pp 552-565) **Iodine trapping and conditioning in the Mercurex system.** Collard, G.E.R.; Hennart, D.; Van Dooren, J.; Goossens, W.R.A. (C.E.N./S.C.K., Mol, Belgium). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

The Mercurex process, followed by adsorption on silvered products, has been retained by the S.C.K./C.E.N. for further investigation of a retention method for both inorganic and organic iodine compounds in reprocessing plant off-gases. A parametric study applied to different iodine compounds has led to a design equation describing the influence of the gas and liquid flow rates and of the nitric acid and mercuric nitrate concentration on the scrubber efficiency. Mass transfer restriction in the liquid phase limits the process rate for CH_3I, while gas phase resistance to mass transfer is determinant for iodine removal. Evolution of the iodine release from a batch-type dissolver during simulated fuel dissolution was studied. The efficiency of the process is influenced mainly by the dissolution grade of the fuel, since it depends on the form of iodine released from the dissolver and from the NO/sub x/ scrubber installed upstream the Mercurex scrubber. An iodine-mercury separation process is proposed for treatment of the spent Mercurex solution. The process consists of the following steps: electrolytic precipitation of mercury after complexation with hydrazonium chloride; elimination of iodine by precipitation on a fixed bed of Cu_2O put on a solid support; recycling of mercuric nitrate after dissolution of mercury in nitric acid; and recovery of the hydrazonium chloride. The process as proposed, is the result of a laboratory study of the different steps. Its major advantage is that the amount of waste generated is limited to a minimum. However, experiments in a larger scale equipment indicate that some modifications might be necessary.

28233 (CONF-801038—(Vol.1), pp 566-584) **Results of cleaning dissolver off-gas in the PASSAT prototype dissolver off-gas filter system.** Furrer, J.; Kaempffer, R.; Linek, A.; Merz, A. (Kernforschungszentrum Karlsruhe, Germany). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

For demonstration of an advanced dissolver off-gas cleaning system the new PASSAT filter system has been developed, set up under licensing conditions pertinent to industrial scale reprocessing facilities and commissioned for trial operation. Major components of the PASSAT off-gas cleaning system are the packed fiber mist eliminator with flushing capability (Brink filter) for initial removal of droplet and solid aerosols, which has been installed to extend the service life of HEPA filters, and the series connected iodine adsorption filters for optimum utilization of the iodine adsorption material, AC 6120. The tests performed so far and the experience accumulated in testing these remotely operated filter components under simulated dissolver off-gas conditions, are described and discussed.

28234 (CONF-801038—(Vol.1), pp 585-596) **Conditioning of reprocessing dissolver offgas prior to Kr-retention by cryogenic distillation.** Ringel, H.D.; Barnert-Wiemer, H.; Hackfort, H.; Heidendael, M. (Kernforschungsanlage Juelich, Germany). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

The separation of Kr-85 from the dissolver off-gas by means of low temperature rectification requires a comprehensive and thorough pre-cleaning of the off-gas. In this section of the off-gas cleaning, work has been carried out which comprises the selection of a catalyst for the reduction of O_2 and NO/sub x/ as well as the separating out of the xenon prior to the low temperature rectification. A ruthenium catalyst showed the best results: O_2 and NO/sub x/ were removed so that the residual amounts were $\leqq$ 1 ppM while at the same time the formation of NH_3 was avoided. The xenon can be adequately removed in freezing traps in quantitative terms but the xenon, that is removed, always contains some 0.2 vol % Kr and/or N_2. In further experiments, the solubility of O_3 in liquid Xe was measured; at 165 K and 1.16 bar overall pressure when a gas phase containing 4.4 Mol % O_3 is in equilibrium with liquid Xe, 0.37 Mol % O_3 dissolved in the liquid Xe.

28235 (CONF-801038—(Vol.1), pp 597-611) **I-129, Kr-85, C-14 and NO/sub x/ removal from spent fuel dissolver off-gas at atmospheric pressure and at reduced off-gas flow.** Henrich, E.; Huefner, R. (Kernforschungszentrum Karlsruhe, Germany). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

A dissolver off-gas (DOG) system suitable for a LWR, FBR or HTR spent fuel reprocessing plant is described, incorporating the following features: (1) the DOG flow is reduced to a reasonably small volume, using fumeless dissolution conditions, by maintaining high concentrations, the retention procedures are simplified and accompanied by an economic reduction of the equipment size;

(2) all process operations are conducted at atmospheric or subatmospheric pressure, including noble gas removal by selective absorption, without using high temperature processes; (3) all processes, except HEPA filtering, are continuous and do not accumulate large amounts of waste nuclides, the DOG process sequence is mutually compatible with itself and with processing in the headend, showing on-line redundancy for the removal of the most radiotoxic nuclides; and (4) the DOG system only deviates slightly from proven technology. The stage of development and relevant results are given both for a lab. scale and a pilot plant scale.

28236 (CONF-801038—(Vol.1), pp 612-627) **Improved iodine and tritium control in reprocessing plants.** Henrich, E.; Schmieder, H.; Roesch, W.; Weirich, F. (Kernforschungszentrum Karlsruhe, Germany). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

During spent fuel processing, iodine and tritium are distributed in many aqueous, organic and gaseous process streams, which complicates their control. Small modifications of conventional purex flow sheets, compatible with processing in the headend and the first extraction cycle are necessary to confine the iodine and the tritium to smaller plant areas. The plant area connected to the dissolver off-gas (DOG) system is suited to confine the iodine and the plant area connected to the first aqueous cycle is suited to confine the tritium. A more clear and convenient iodine and tritium control will be achieved. Relevant process steps have been studied on a lab or a pilot plant scale using I-123 and H-3 tracer.

28237 (CONF-801038—(Vol.1), pp 628-636) **Some aspects of aerosol production and removal during spent fuel processing steps.** Herrmann, F.J. (Gesellschaft zur Wiederaufarbeitung von Kernbrennstoffen, Karlsruhe, Germany); Lang, E.; Furrer, J.; Henrich, E. Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Modern requirements for a very high decontamination factor of the order of $\sim 10^9$ for off-gas radioactive emissions are not easily achieved with the usual off-gas purification treatments. Control and minimization of activity-loaded aerosols must be initiated at the source. To help the reprocessing plant designer, a systems analysis has been made in which aerosol sources are recorded, and measures for reducing the discharge of radioactivity are illustrated. The aerosol discharge has been simulated and demonstrated in test rigs. Results from one such dissolver test rig are shown, in which 10^{-8} to 10^{-9} of the total dissolver activity goes to the filters. Tests show that the off-gas has an aerosol loading of 10 mg/m³ gas. The values quoted are specific for the apparatus used. It was found that the air introduced for stirring purposes into the vessel off-gas system of the extraction cycles, was also a most important source of aerosol production, giving a simular aerosol loading.

28238 (CONF-801038—(Vol.1), pp 638-663) **Aerosol filtration.** First, M.W. (Harvard School of Public health, Boston, MA); Gilbert, H. Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Significant developments in high efficiency filtration for nuclear applications are reviewed for the period 1968 to 1980. Topics of special interest include factory (bench) and in-place test methods, new developments in paper and filter unit construction methods, vented containment air cleaning systems for LMFBR and light water moderated reactors, and decontamination of offgases from nuclear waste volume reduction processes. It is noted that standards development has been vigorously pursued during this period but that advances in filtration theory have been few. One of the significant changes likely to occur in the immediate future is adoption of the European style of HEPA filters for those that have been in service for the past three decades to obtain the benefits of having almost twice as much filter paper in the same filter cartridge. 71 references.

28239 (CONF-801038—(Vol.1), pp 667-681) **Survey of loading performance of currently available types HEPA filters under in-service conditions.** Gunn, C.A.; McDonough, J.B. (Mine Safety Appliances Co., Evans City, PA). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Atmospheric dust loading tests were conducted on various industrial grade High Efficiency Particulate Air Filters. The filters tested were the European Style, Super-Flow, Standard US Design, and a Super-Pak. Filters were installed on the roof of a 3-story building. Test flows were set at a media velocity of 5 FPM (1.52 meters per min) and results show that filter life varies from 8.8 to 12.7 months. In addition, tests were coucted on the European Style filter at media velocities of 5.6 and 2.6 FPM. On the filter tested at 5.6 FPM an abrupt change in life was observed at 4 months. After more than 1 year operation at a lower velocity of 2.6 FPM the pressure rise with time is still very slow.

28240 (CONF-801038—(Vol.1), pp 682-696) **Performance of 1000- and 1800- cfm HEPA filters on long exposure to low atmospheric dust loadings, II.** First, M.W.; Rudnick, S.N. (Harvard Air Cleaning Lab., Boston, MA). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Comparative tests were made to evaluate the performance characteristics of American- and European-design HEPA filters when exposed, for a number of years, to aerosols characteristic of nuclear and biohazard service. Although some of the European-design filters were operated at their rated airflow capacity of 1800 cfm, some were downrated to 1000 cfm to determine if their service life could be more than tripled compared to conventional 1000-cfm Americal-design HEPA filters, as filter theory predicts. Initial results indicate, however, that for the ambient aerosol used in this study, a European-design filter has a service life of only 1.6 times greater than an American-design filter when both operate at 1000 cfm. Further tests are in progress to verify this result.

28241 (CONF-801038—(Vol.1), pp 697-707) **Preliminary assessment of the dust loading versus pressure drop characteristic of high capacity HEPA filters.** Pratt, R.P. (Atomic Energy Authority, Harwell, England). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

A design of High Efficiency Particulate Air (HEPA) filter offering enhanced flow capacity on conventional deep-pleat designs has been developed in Europe and is now available from several manufacturers. These filters offer significant reductions in the physical size of filtration installations and are also claimed to have an extended service life. Dust loading versus pressure drop tests have been carried out on filters from two manufacturers using both ASHRAE and BS 2831 No. 2 test dusts at a flow rate of 3400 m³/h and also downrated to 1700 m³/h. Similar tests have been carried out on conventional deep-pleat design filters rated at 1700 m³/h as a datum base for a comparison of performance for the two designs. These initial results suggest that the high capacity filter might be used to advantage by plant designers in one of two ways. A significantly greater dust loading and hence filter life can be obtained by operating the filters at half their rated capacity. Alternatively the high flow rates can be used to reduce the size of a given installation but with a resulting reduction in the life of the filter. Unexpectedly large differences were found between the filters from the two sources. This suggests that further work is required to compare products from all sources in order to optimize the potential savings from adoption of the new design.

28242 (CONF-801038—(Vol.1), pp 708-718) **Cleanable sintered metal filters in hot off-gas systems.** Schurr, G.A. (E.I. du Pont de Nemours and Co., Inc., Wilmington, DE). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Filters with sintered metal elements, arranged as tube bundles with backflush air cleaning, are the equivalent of bag filters for high-temperature, harsh environments. They are virtually the only

alternative for high-temperature off-gas systems where a renewable, highly efficient particle trap is required. Tests were conducted which show that the sintered metal elements installed in a filter system provide effective powder collection in high-temperature atmospheres over thousands of cleaning cycles. Such a sintered metal filter system is now installed on the experimental defense waste calciner at the Savannah River Laboratory. The experimental results included in this paper were used as the basis for its design.

28243 (CONF-801038—(Vol.1), pp 719-744) **High efficiency particulate removal with sintered metal filters.** Kirstein, B.E. (Science Applications, Inc., San Diego, CA); Paplawsky, W.J.; Pence, D.T.; Hedahl, T.G. Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Because of their particle removal efficiencies and durability, sintered metal filters have been chosen for HEPA filter protection in the off-gas treatment system for the proposed Idaho National Engineering Laboratory Transuranic Waste Treatment Facility. Process evaluation of sintered metal filters indicated a lack of sufficient process design data to assume trouble-free operation. Subsequent pilot-scale testing was performed with fly ash as the test particulate. The test results showed that the sintered metal filters can have an efficiency greater than 0.9999999 for the specific test conditions used. Stable pressure drop characteristics were observed in pulsed and reversed flow blowback modes of operation. Over 4900 hours of operation were obtained with operating conditions ranging up to approximately 90°C and 24 volume percent water vapor in the gas stream.

28244 (CONF-801038—(Vol.1), pp 772-781) **Influence of thermophoresis on particle removal in a moving granular bed filter and heat exchanger.** Rudnick, S.N.; First, M.W.; Price, J.M. (Harvard Air Cleaning Lab., Boston, MA). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Bench-scale investigations were made to determine the influence of thermophoresis on particle removal in a moving granular bed filter. A continuous flow of 2-mm diameter ceramic granules at ambient temperature entered the top of the filter and moved slowly downward under the influence of gravity countercurrent to the gas stream. At an inlet gas temperature of 240°C, gas mass velocity of 0.12 kg/(s.m^2), and granule velocities up to 0.015 cm/s, clean bed collection efficiency for a submicrometer sodium chloride aerosol was found to increase the more the gas was cooled, indicating that thermophoretic forces were playing a measurable role in particle collection.

28245 (CONF-801038—(Vol.1), pp 782-806) **Development of acid-resistant HEPA filter components.** Terada, K.; Woodard, R.W.; Buttedahl, O.I. (Rockwell International, Golden, CO). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Laboratory and in-service tests of various HEPA filter media and separators were conducted to establish their relative resistances to HNO_3-HF vapors. Filter medium of glass fiber with Nomex additive and aluminum separators with an epoxy-vinyl coating have performed quite well in the acid environment in the laboratory, and in prototype-filters placed in service in a plenum at Rocky Flats. Proprietary filters with new design and/or components were also tested in service with generally good results.

28246 **(CONF-801038—(Vol.2)) 16th DOE nuclear air cleaning conference: proceedings.** First, M.W. (ed.). (Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab.). Feb 1981. 693p. NTIS, PC A99/MF A01. Order Number DE81026621.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Major topics discussed during the Sixteenth DOE Nuclear Air Cleaning Conference were: waste treatment, including volume reduction and storage; system and component response to stress and accident conditions; Three Mile Island accident; iodine adsorption; treatment and storage of noble gas: treatment of offgases from chemical processing; aerosol; behavior; containment venting; laboratory and in-place filter-testing methods; and particulate filtration. Volume I of the Proceedings has 49 papers from the following sessions; HEPA filter test methods; noble gas separation; air cleaning system design; containment venting; iodine adsorption; reprocessing offgas cleaning; critical review; filtration; filter testing; and aerosols. Volume II contains 44 papers from the sessions on: nuclear waste treatment; critical review; noble gas treatment; carbon-14 and tritium; air cleaning system response to stress; nuclear standards and safety; round table; open end; and air cleaning technology at Three Mile Island. Abstracts are provided for all of these papers.

28247 (CONF-801038—(Vol.2), pp 867-890) **Chemical behavior of radioiodine under loss of coolant accident conditions.** Kabat, M.J. (Ontario Hydro, Toronto). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

An experimental study on radioiodine behavior and its release and control under loss of coolant accident conditions is being carried out at Ontario Hydro. The reaction of I_2 vapor with H_2O (25° to 85°C) and steam (100° to 120°C) was experimentally evaluated, using a species selective sampler to determine the concentrations of airborne radioiodine species. The formation and release of chemical species were strongly dependent on water temperature. More than 90% of iodine was released as HOI at $\geqq$ 60°C, with relatively small amounts of organic species formed under the above conditions. A significant portion of radioiodine also remained airborne after mixing I_2 vapor with air and steam and subsequently condensed at 25° to 80°C. Hypoiodous acid was the major species formed in all experiments. Desorption and composition of iodine species released from the condensate was also evaluated. Desorption of $>$ 1% in the first few hours was measured and HOI was again found to be the major component. Airborne HOI was found to be relatively stable under normal conditions, while it rapidly decomposed when heated to $\geqq$ 250°C or exposed to high intensity uv light. Mass spectrometric analysis of species evolved from aqueous radioiodine solutions showed distinct mass peaks at 143 and 161, corresponding to IO^- and $IO^-.H_2O$ respectively. This strongly supports the presence of HOI as a stable airborne iodine species.

28248 (CONF-801038—(Vol.2), pp 891-910) **Nuclear waste vitrification effluent.** Goles, R.W.; Brauer, F.P.; Hamilton, D.C.; Fager, J.E. (Battelle Pacific Northwest Labs., Richland, WA). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Important gaseous and airborne off-gas emissions associated with the solidification of high level liquid waste have been characterized. Effluents specifically sampled for in this off-gas monitoring study include: the gaseous chemical species of ^{3}H, ^{14}C, ^{85}Kr, ^{129}I and NO/sub x/; the semivolatile forms of ^{79}Se, ^{99}Tc, ^{106}Ru, ^{125} ^{126}Sb, /sup 125m/Te and ^{134} ^{135} ^{137}Cs; and all radionuclides contained in particulate matter. The sampling and laboratory techniques employed and the off-gas analytical results obtained in this study are described herein. In addition, the magnitudes of vitrification-produced gaseous emissions are compared, whenever possible, to those associated with the complete fuel reprocessing cycle

28249 (CONF-801038—(Vol.2), pp 911-928) **Behavior of selected contaminants in liquid-fed ceramic melter waste-vitrification off gas.** Oma, K.H.; Nelson, T.A. Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Vitrifying (immobilizing) high-level radioactive waste into a borosilicate glass is one method being developed for converting the wastes to a stable form for disposal. One promising process approach makes use of the liquid-fed, joule-heated ceramic melter. In this process, simulated high-level liquid wastes are fed directly to the melter, eliminating the calcining step used in previous concepts to dry the wastes before introducing them into the melter. A good understanding of the types, forms and quantities of wastes passing from the process to the off-gas cleanup requirements for this kind of waste vitrification. Tests have been performed during direct liquid-feeding of simulated high-level defense waste to a ceramic melter to characterize and quantify the gases, semivolatiles, and

solids in the off-gas stream. The effluent sampling apparatus consisted of a wet scrubbing system, a plating sampler assembly, a gas chromatograph, and a classical scattering aerosol spectrometer. Tracer elements present in the nonradioactive, simulated waste feed were strontium, ruthenium, antimony, tellurium, and cesium. Temperatures in a liquid-fed ceramic melter range as high as 1200°C in the molten glass. At these temperatures, the tracer isotopes of primary concern are ruthenium and cesium. Chloride and sodium were the two major volatile species present in the off gas. High chloride levels pose potential corrosion problems for the melter lid and the effluent system. Due to the high chloride and sodium volatility observed, entrainment losses from the melter to the effluent treatment system account for only 10% to 30% of the total losses. Particulate decontamination factors from feed to off gas in the melter system ranged from 5 x 10^2 to greater than 10^3 without any filtration or treatment.

28250 (CONF-801038—(Vol.2), pp 989-1017) **Critical review of noble gas treatment systems.** Pence, D.T. (Science Applications, Inc., San Diego, CA). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Noble gas treatment systems for various applications in the nuclear industry are reviewed and discussed. The applications considered include nuclear fuel reprocessing, reactor waste gas treatment systems, and reactor emergency noble gas recovery systems. The status of technology and development work in progress is discussed. Radioactive noble gases are emitted from a number of sources in the nuclear fuel cycle, so to limit the scope of this review only control systems for the removal of krypton and xenon will be considered and only from the effluents of light water reactors (LWRs) and facilities in which the LWR fuel is reprocessed. Also, the following discussion is limited to describing some of the technologies that have been proposed for use in controlling krypton from many of these sources and to comment on the status of their development and probable effectiveness.

28251 (CONF-801038—(Vol.2), pp 1019-1033) **Conditioning and storage of fission product krypton using continuous ion implantation into sputtered metals.** Schmidt, H.J. ; Henrich, E.; Baumgaertner, F. (Kernforschungszentrum Karlsruhe, GmbH, Germany). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Krypton ion implantation into sputtered metals promises to offer improved safety during conditioning and storage or disposal of fission product krypton separated in spent fuel reprocessing plants, and has been investigated on a lab scale. Amorphous and crystalline metal deposits have been sputtered using an unsupported glow discharge at about 10^{-2} Torr in the annular gap between two concentric cylinder electrodes. The krypton was implanted into the continuously growing metal coating collected inside the outer cylinder. A sputtering voltage of about -3 kV was applied to the inner cylinder and an implantation voltage to the outer cylinder of either -0.3 kV for amorphous or about -1 kV for crystalline metal deposits. The end electrodes have been earthed. Amorphous Fe-Zr and Cu-Zr products contained up to 7 at. % Kr. In crystalline Cu up to 5 and in crystalline Ti up to 8 at. % Kr have been determined. The minimum power consumption for the implantation process corresponded to about 10 ppM of the reprocessed reactor power for the amorphous alloys and to about 20 ppM for crystalline Ti. Material and power consumption are reasonably low. In the amorphous alloys a monoatomic krypton distribution is suggested from neutron scattering results. In the crystalline Cu or Ti the Kr is contained in small bubbles. The thermal release rates of the Kr containing coatings have been determined in a linear temperature gradient up to 10^3 °C and at constant temperatures until steady state conditions were obtained at higher temperatures. The small initial low temperatures release rates were found to decrease with time, additional coating with the pure metal or thermal annealing at higher temperature. They have been therefore associated with the release from the surface regions. The extrapolated thermal release rates for amorphous Fe-Zr and crystalline Ti samples have been determined.

28252 (CONF-801038—(Vol.2), pp 1034-1046) **Long-term storage of Kr-85 in zeolite 5A.** Penzhorn, R.D. (Kernforschungszentrum Karlsruhe, GmbH, Germany). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

From experiments on the fixation of Ar, Kr and Xe in the temperature range 400 to 550°C and pressures between 100 and 2000 bar in zeolites of type A, it was discovered that, when the zeolite is exchanged with divalent cations (Mg, Ca and Sr), the encapsulated noble gas brings about a collapse of the crystalline structure (glassification or sintering.). This effect is essentially independent of the amount of gas sorbed. In addition, the zeolite containing trapped gas looses its ability to sorb H_2O. CO_2 and other gases. Since a reloading after desorption at elevated temperatures is not possible, it may be concluded that the alteration of crystal structure after encapsulation is permanent. The obtained product has remarkable properties with regard to the long-term storage of Kr-85, i.e. no significant gas leakage is apparent even after 8 month at 450°C, several days of storage under water or irradiation with γ-rays within the dose range 0.3-3.0x10^8 rad. Systematic experiments were carried out to optimize the encapsulation. In this context the effect of the cationic composition, the pretreatment, the fixation temperature, the fixation pressure, the type of noble gas, etc. was examined. The results indicate that an adequate loading (20 to 30 cm^3 STP Kr/g) can be obtained at 520°C and pressures well below 500 bar. A further improvement can be achieved with a monolithic block (density increase by a factor of about 2). It was demonstrated that, instead of mechanical compression, cryogenic pumping followed by PVT compression can be employed for the encapsulation of Kr. The result is a simplified process with improved safety.

28253 (CONF-801038—(Vol.2), pp 1047-1058) **Long-term storage of radioactive krypton using adsorbent and a double cylinder.** Yamamoto, Y. (Kobe Steel, Ltd., Japan); Sawada, Y.; An, B.; Inada, E. Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Long-term storage of krypton gas is important from the viewpoint of reducing the release of radioactivity to the atmosphere. The storing method using adsorbent is anticipated to be brought into practical use as an intermediate storing method before the final disposal and/or storage technology of krypton gas is established. The concept of remote-controlled storage system for krypton has been studied and clarified with a process involving a double cylinder and adsorbent. Experimental studies on adsorption and heat transfer characteristics of adsorbent and storage gas systems have also been performed. When stored, the temperature inside the cylinder increases due to the decay heat of krypton-85. Then a part of the krypton adsorbed on the adsorbent is desorbed and the pressure inside the cylinder is apt to rise. However, from the experimental and analytical studies, the capability of storage at a lower pressure inside the cylinder by dint of the adsorbing effect compared with the pressure without adsorbent was confirmed.

28254 (CONF-801038—(Vol.2), pp 1072-1082) **Experimental development and design aspects of a ^{85}krypton removal distillation unit.** Collard, G.E.R.; Geens, L.P.M.; Vaesen, P.J.; Goossens, W.R.A.; . (SCK/CEN, Mol, Belgium). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Cryogenic distillation as a method for the removal of krypton from gaseous effluents of reprocessing plants has been studied with non active gases at the pilot scale of up to 0.010 $kg.s^{-1}$ through-put (30 STP $m^3.h^{-1}$), in a packed bed configuration. Pressure and temperature of the feed, reflux rate, heating power of the kettle of the column are the most important parameters which have been studied in order to avoid crystallization of xenon in the precoolers as well as formation of solid phase xenon-nitrogen mixtures in the column. The use of a simple thermal regulation system, based on the narrow separation front of two components, made it possible to fulfil the mass- and heat-balances in order to condense variable quantities of noble gases, representing a mean accumulation to feed mass ratio of down to 0.01%. The unit has continuously worked troubleless during more than 13,000 hours with an average avail-

ability factor of 99.70%. During this long campaign supply of cooling nitrogen appeared to be the most critical part of the unit. Indeed, during 0.20% of the time the unit had to be worked batchwise for its maintenance. It appears that nitrogen containing up to 1% argon, 10 to 2000 ppM krypton and up to 8000 ppM xenon can be continuously treated by distillation acquiring large krypton decontamination factors without any problems due to the high xenon concentration and without accumulation of other compounds than xenon and krypton in the kettle of the column.

28255 (CONF-801038—(Vol.2), pp 1175-1192) **Seismic qualification of HEPA filters by test in an actual operating condition.** Yow, J.R. (Corporate Consulting and Development Co., Ltd, Raleigh, NC); Holloman, R.; Algar, A. Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Flander's Filters, Inc., has completed an analysis and test program which has resulted in a seismically prequalified high efficiency particulate air (HEPA) filter housing with the HEPA filters installed and operating during the qualification testing. The nuclear seismic qualification program was performed by Corporate Consulting and Development Company, Ltd. During the seismic qualification testing a dioctylphthalate (DOP) test was performed for the duration of the shake table test and the system performed successfully. The details of the seismic qualification test procedure, housing and filter design, and the structural performance results are presented. Comparisons are made between theoretically predicted results and test results. The preliminary test program pointed out some potential vibration problems with separator type filters due to media puncture during shaking. HEPA filters have typically been given less emphasis from a seismic qualification standpoint than the primary structure and equipment (such as fans, cooling coils, heaters, etc.) in filter trains and/or air handling units. This nuclear seismic qualification program has shown that this design for filters and housing will withstand the seismic occurrence and perform its required safety related function during and after the seismic occurrence. Conclusions resulting from this test program are presented and some recommendations and precautions are given.

28256 (CONF-801038—(Vol.2), pp 1281-1283) **Challenges for nuclear air cleaning technology in France.** Rouyer, J.L. Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

The current evolution of nuclear air cleaning research and engineering and the technological developments needed for improving protection and safety are described. The subjects covered are: iodine and HEPA filters testing; cleaning of reprocessing process gas; plutonium aerosol filtration; and air cleaning in accident situations.

28257 (CONF-801038—(Vol.2), pp 1284-1291) **Developments in nuclear air cleaning in Germany.** Furrer, J. (Kernforschungszentrum Karlsruhe, GmbH, Germany). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

New filter designs for nuclear power plants and reprocessing plants are discussed. For nuclear power plants the following are discussed: prefilter; drum filter; high temperature filters; electrostatic precipitators; radioiodine filters. An off-gas section for dissolver off-gas cleaning in a reprocessing plant is being tested at the Karlsruhe Nuclear Research Center. The following specific tests are discussed: head end test rig: PASSAT dissolver off-gas filter; reduction of oxygen and nitrogen oxides; precleaning device; and krypton low temperature rectification. Features of a backup solution for dissolver off-gas cleaning are also mentioned.

28258 (CONF-801038—(Vol.2), pp 1292-1297) **New trends in the Belgian programme on nuclear air cleaning technology.** Goossens, W.R.A. (SCK/CEN, Mol, Belgium). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

In the Belgian Programme on nuclear air cleaning technology the Mercurex process has been developed to trap iodine compounds from dissolver off-gases. Krypton is removed with the help of a cryogenic distillation unit. The various gas cleaning units have been integrated in a gas purification test loop for dissolver off-gas at a through put of 25 m^3 gas h^{-1}. The separation of tritium from liquid reprocessing effluents is being developed according to the ELEX-process. New research is started on the capture of semi-volatile ruthenium compounds.

28259 (CONF-801038—(Vol.2), pp 1248-1301) **Recent developments in the testing of absorbers in ventilation systems.** Kabat, M.J. (Ontario Hydro, Pickering, Ontario). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

A centralized filter testing service was established in Ontario Hydro nuclear power stations in 1976. This includes acceptance and surveillance testing of the integrity of air cleaning assemblies and determination of absorber efficiency for the removal of airborne iodine species including hypoiodous acid. From the results of this program it has been concluded that HOI penetrated impregnated charcoal less than CH_3I, but it is more penetrative than elemental iodine under standard testing conditions. Most of the charcoal samples were at least 10 times more efficient for HOI than for CH_3I removal and at least 2 times less efficient for HOI than for elemental iodine removal. Long term desorption tests are presently in progress.

28260 (CONF-801038—(Vol.2), pp 1302-1304) **Advances in air cleaning technology in the UK.** Marshall, M. (AERE, Harwell, England). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Advances in the field of nuclear air cleaning technology in the UK are summarized. Two main categories covered are filtration and gaseous wastes. Under filtration the following are discussed: standards; prefilters; cylindrical filter development; sealing and change techniques; filter loading; storage and disposal; and filter testing. Progress is being made over a wide front but it is generally, slow and steady with no obvious breakthroughs. The main objective in the field of filtration at present is to minimize the quantity of waste for storage or disposal.

28261 (CONF-801038—(Vol.2), pp 1308-1320) **New air cleaning technology in Japan.** Yoshida, Y.; Kitani, S.; Matsui, H.; Ikezawa, Y. (Japan Atomic Energy Research Inst., Tokai). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Application of the new techniques and improvements in air cleaning systems have been made to reduce release of radioactive materials from nuclear facilities based on the ALARA concept. For example, the reduction of release of radioactive gaseous effluents has been made by installation of a charcoal gas hold-up system and a clean steam supply system for a turbine gland seal in a BWR and of a gas decay tank system in a PWR. In connection with the effort for reduction of releases in plants, research and development on air cleaning technology have also been made. Some activities mentioned in the present paper are: removal of particulates, airborne radioiodine, noble gases and tritium; penetration characteristics of submicron DOP aerosol for HEPA filters; radioiodine removal from air exhausts; and operational performance of the incineration plants using ceramic filters.

28262 (CONF-801038—(Vol.2), pp 1401-1406) **Effect of flow rate on the adsorption coefficient of radioactive krypton on activated carbon.** Sun, L.S.C.; Underhill, D.W. Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

For some time, there have been questions relative to the effect of carrier gas velocity on the adsorption coefficient for radioactive noble gases on activated charcoal. Resolution of these questions is particularly important in terms of developing standard procedures for determining such coefficients under laboratory conditions. Studies at the Harvard Air Cleaning Laboratory appear to confirm that the adsorption coefficient for radioactive krypton on activated charcoal is independent of the velocity of the carrier gas.

28263 (CONF-801038—(Vol.2), pp 1481-1499) **Radioiodine adsorption geometry effects.** Grimm, J.J.; Freeman, W.P.; Hunt, J.R.; Fleming, K.M.; Kovach, J.L.; Jacox, J.W. (Nuclear Consulting Services, Inc., Columbus, OH). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Some effects of, and information obtainable from, geometric considerations of the internal geometry of an adsorption bed are the subject of this paper. Two major areas are covered. First the capture/release data obtainable with proper analysis of a heavy loaded (with I131) bed. Second, the effects of sampling adsorbents for the standard ASTM D3803-79 efficiency tests relative to preserving the internal geometry of the sample vs a homogeneously mixed sample. Analysis of highly contaminated carbon from the TMI Unit II accident and subsequent laboratory simulation tests confirm that useful data on iodine captured and released can be obtained under certain conditions. Experimental test data per ASTM D3803-79 indicates that a homogeneously mixed sample of a poisoned adsorbent is always a conservative result when compared to a sample tested with its internal geometry preserved. That is, the test efficiency from a homogeneously mixed sample is always slightly lower than the same sample tested with the internal geometry preserved. This result confirms the essentially universal sampling and testing practices in use in the United States today will err only in the direction of conservatism (i.e., maximum safety).

28264 **(CONF-810606—81) Effects of source-fissile material distributions on the accuracy of time correlated counting.** Cannon, J.W. (EG and G Idaho, Inc., Idaho Falls (USA)). 1981. Contract AC07-76ID01570. 5p. NTIS, PC A02/MF A01. Order Number DE81027125.

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

Time correlated counting has been proposed as a possible criticality monitor at the Transuranic Waste Treatment Facility (TWTF). This paper investigates possible errors which might arise in estimates of k/sub eff/ due to the assumption implicit in time correlated counting, that neutron multiplication is constant from generation to generation. It appears that the assumption of uniform multiplication of neutrons between generations will not generally produce large errors in time correlated counting. However, a point source at the edge of a system could produce large errors.

28265 **(CONF-810722—3) Mobile species of Pu, Np, Cm, Am and Tc in the environment.** Bondietti, E.A. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 2p. NTIS, PC A02/MF A01. Order Number DE81026520.

From International symposium on migration in the terrestrial environment of long-lived radionuclides from the nuclear fuel cycle; Knoxville, TN, USA (27 Jul 1981).

This paper will describe field and laboratory findings on the nature of soluble species of plutonium, neptunium, curium, americium, and technetium and demonstrate the importance of oxidation state and complexing ligands on migration potential. Both of these geochemically-influenced variables are difficult to incorporate into models, yet significantly influence actual migration if it occurs.

28266 **(DOE/DP/01253—19) Interim report on flash floods, Area 5 - Nevada Test Site.** French, R.H. (Nevada Univ., Las Vegas (USA). Desert Research Inst.). Sep 1980. Contract AC08-76DP01253. 34p. NTIS, PC A03/MF A01. Order Number DE81027528.

Examination of the presently available data indicates that consideration must be given to the possibility of flash floods when siting waste management facilities in Area 5 of the Nevada Test Site. 6 figures, 7 tables.

28267 **(DOE/ER/00884—4) Use of polyethers in the treatment of acidic high-activity nuclear wastes. Final report, May 31, 1975-August 31, 1980.** Davis, M.W. Jr. (South Carolina Univ., Columbia (USA). Coll. of Engineering). 21 May 1981. Contract AS09-76ER00884. 62p. NTIS, PC A04/MF A01. Order Number DE81027087.

A solvent extraction system has been developed which will reversibly extract Cs^{+1} from 3M HNO_3. The organic phase consists of a matrix solution of 27 vol% TBP, and 68 vol% kerosene. The complexing agents consist of (.076M) 5 vol% didodecylnaphthalene sulfonic acid (DNS) and .02M Bis (4,4'(5') [1-hydroxyheptyl]benzo) 18-crown-6. This is a synergistic system since both complexing agents are necessary to extract the cesium. The data indicate that one crown molecule is involved in the organic complex while the number of DNS molecules is at least one to satisfy the valence requirements but may be more since surfactants of the DNS type tend to form small aggregates in the organic phase. This lack of extraction is probably due to steric effects around the extracted metal atom when two or three ionized DNS molecules are required for valence adjustment. Radiation stability studies of this extraction system at 10^7 rad delivered over a one hour period show a decrease in the cesium distribution coefficient (D org/aq) of a factor of two with the pure radiation D org/aq = 1 about or = 2 and the post radiation D org/aq) = .5 about or = 1 (ideal for a solvent extraction system). Whatever the degradation products were, they did not interfere with the reversibility of the extraction. From an hydraulic viewpoint, the phases settled very quickly with little entrainment although mixer settler runs have not been made. The one serious problem with this extraction system is the low solubility of the crown compound (.02M) and therefore its low metal carrying capacity. The Parish Chemical Company of Provo, Utah was asked to hydrogenate the benzene rings attached to the crown which always results in a large increase in the organic and aqueous solubilities. Tests of the extraction capability of this new compound have not yet been undertaken.

28268 **(DOE/ET/41900—8) Preparation of nonradioactive substitutes for radioactive wastes.** Kupfer, M.J. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). 31 Jul 1981. Contract AC09-79ET41900. 56p. (ESG-DOE—13352). NTIS, PC A04/MF A01. Order Number DE81028502.

Because of the difficulties in obtaining and working with actual radioactive waste, most experiments involving development of ceramic materials for nuclear waste fixation are performed using simulated wastes. Procedures for preparing simulated nuclear wastes that exhibit physical and chemical properties similar to those of actual wastes are given in this report. The synthetic wastes were formulated using conditions similar to those defined in the original process flowsheets. Recipes suitable for laboratory-scale or pilot-scale preparation are given for wastes found at the Savannah River Plant, Hanford Site, Idaho Chemical Processing Plant, and the Western New York Nuclear Service Center facility. Recipes are also given for waste that is likely to be generated from future reprocessing of spent commercial nuclear fuels.

28269 **(DOE/ET/46608—1) High-level nuclear-waste disposal: information exchange and conflict resolution.** Hadden, S.G.; Chiles, J.R.; Anaejionu, P.; Cerny, K.J. (Department of Energy, Washington, DC (USA)). Jul 1981. 237p. NTIS, PC A11/MF A01. Order Number DE81028818.

The research presented here was conceived as an exploration of the interactions among parties involved in the resolution of the high-level radioactive waste (HLW) disposal issue. Because of the major differences in the nature of the interactions between levels of government, on the one hand, and between government and the public, on the other hand, this study is divided into two primary areas - public participation and intergovernmental relations. These areas are further divided into theoretical and practical considerations. The format of the paper reflects the divisions explained above as well as the interaction of the various authors. Public participation is addressed from a theoretical perspective in Part 2. In Part 3 an essentially pragmatic approach is taken drawing on experiences from similar exercises. These two aspects of the study are presented in separate parts because the authors worked largely independently. Intergovernmental relations is treated in Part 4. The treatment is organized as two Sections of Part 4 to reflect the authors' close interaction which yielded a more integrated treatment of the theoretical and practical aspects of intergovernmental relations. Detailed recommendations and conclusions appear in the final subsections of Parts 2, 3, and 4. Part 5, Summary and Conclusions, does not reiterate the detailed conclusions and recommendations presented in previous parts but rather expresses some general perceptions with respect to the high-level waste disposal issue. A brief review of the Table of Contents will assist in visualizing the de-

tailed format of this study and in identifying the portions of greatest relevance to specific questions. A detailed Subject Index and an Acronym Index have been included for the reader's convenience.

28270 **(DOE/NV/10061—7) Quality-Assurance Program Plan.** Kettell, R.A. (Westinghouse Electric Corp., Mercury, NV (USA). Advanced Energy Systems Div.). May 1981. Contract AC08-80NV10061. 74p. NTIS, PC A04/MF A01. Order Number DE81028257.

This Quality Assurance Program Plan (QAPP) is provided to describe the Quality Assurance Program which is applied to the waste management activities conducted by AESD-Nevada Operations at the E-MAD Facility located in Area 25 of the Nevada Test Site. The AESD-Nevada Operations QAPP provides the necessary systematic and administrative controls to assure activities that affect quality, safety, reliability, and maintainability during design, procurement, fabrication, inspection, shipments, tests, and storage are conducted in accordance with established requirements.

28271 **(DOE/NWTS—80(2)) Geologic disposal of radioactive waste: program plan for field tests in salt.** (Battelle Columbus Labs., OH (USA)). Apr 1981. Contract AC06-76RL01830. 95p. NTIS, PC A05/MF A01. Order Number DE81028790.

A series of program plans is being developed to address the field testing needs for various candidate repository host rocks: salt, granitic, tuff, and basalt. This document, NWTS-80(2), is the second plan of the series, and is intended to define and clarify the issues introduced in NWTS-80(1) as they apply specifically to salt. The series of Field Testing Program Plans (the NWTS-80 series) is as follows: (1) NWTS-80(1): Geologic Disposal of Radioactive Waste: Program Plan for Field Tests in Geologic Formations; (2) NWTS-80(2): Program Plan for Field Tests in Salt; (3) NWTS-80(3): Program Plan for Field Tests in Granitic Rock; (4) NWTS-80(4): Program Plan for Field Tests in Tuff at Hanford; (5) NWTS-80(5): Program Plan for Field Tests in Tuff at NTS. The topics addressed by NWTS-80(1) include: definition of field testing; role of field testing in repository development; technical issues to be addressed by field testing; and application of field testing results. NWTS-80(1) discusses these topics generally in application to all candidate host rock types in response to the general issues raised by other NWTS planning documents, the Earth Science Technical Plan and the NWTS Rock Mechanics Plan. Subsequent plans in this series discuss these topics in detail as they apply to specific rock types, resulting in a program plan series that can be used as a basis for further development of specific tests.

28272 **(DOE/SR-WM—79-3-Rev.5/81) Strategy document long-term high-level waste technology program.** (Department of Energy, Aiken, SC (USA). Savannah River Operations Office). May 1981. 57p. NTIS, PC A04/MF A01. Order Number DE81026337.

This strategy document presents the research and development plan of the Office of Waste Operations and Technology for long-term immobilization of the high-level radioactive wastes resulting from chemical processing of nuclear reactor fuels and targets. The basic DOE plan to achieve the goal of immobilizing all US nuclear high-level wastes (HLW) for terminal storage is: (1) to develop technology to support a realistic choice of an isolation system for each DOE HLW site and for any commercial HLW sites; (2) to develop the candidate waste immobilization forms and processes with sufficient scale-up to provide design data for full-scale facilities; and (3) to construct and operate the facilities necessary to immobilize the DOE defense wastes. The plan is designed to provide the earliest practical demonstration of high-level waste immobilization, and still allow sufficient time for waste form assessment and for public interactions. The Savannah River Plant was chosen as the site for the first defense HLW immobilization plant because the SRP high-level wastes are expected to present minimum problems in retrievability, chemical composition, heterogeneity, and heat load. The contents of this document are as follows: Introduction and Problem Definition; Management Plan for National High-Level Waste Immobilization; High-Level Waste Descriptions; Waste Assessment Programs at Defense Processing Sites; Development of High-Level Waste Forms for Terminal Storage; Characterization of High-Level Waste Forms; Processing of High-Level Waste Forms; Systems Analysis; Public Interactions; Implementation; Bibliography; and Appendices.

28273 **(DOE/TIC—11405) Index to the 1st through 16th AEC/ERDA/DOE nuclear air cleaning conferences.** Burchsted, C.A. (Oak Ridge National Lab., TN (USA)). Feb 1981. Contract W-7405-ENG-26. 353p. NTIS, PC A16/MF A01. Order Number DE81026622.

The Proceedings of the sixteen conferences comprise a vertible encyclopedia on the technology of nuclear air and gas treatment and the control of airborne nuclear waste. These Proceedings cover the history of the technology; describe most of the research and developments in the field, worldwide, since the early 1950's; describe the problems that have been encountered and the solutions found to those problems; and summarize experience with equipment and systems developed for the control of airborne radioactive wastes in laboratory, radiochemical, and reactor operations, both government and commercial. The problem with this encyclopedia is that there has been no index to it; there has been no easy way for searching it to find what was available. This index fills the gap. The first conference was an informal meeting of a number of interested parties from among the then AEC contractors. Consequently, there were no proceedings for that meeting. The subsequent conferences, with their years, locations, and Proceedings numbers, are listed. This index consists of three parts: a tabulation of papers and their authors by paper number (Part I); a tabulation of papers and their paper numbers by author (Part II); and a key-word-in context (KWIC) index of papers. The paper number is a two-part designation consisting of the number of the conference (2, 3...16) followed by the page number of the paper in the corresponding Proceedings. The author index lists each author who has participated in the air cleaning conferences over the years, and the paper index lists all authors of the respective papers. The KWIC index is, in effect, a comprehensive subject cross index; each paper is listed as many times, by keyword, as there are major terms (i.e., keywords) in its title. Although this multiple listing results in a lengthy list, it provides a very deep cross-indexing of the papers.

28274 **(DOE/TIC—11472) Evaluation and review of alternative waste forms for immobilization of high level radioactive wastes. Report number 3.** (Department of Energy, Washington, DC (USA). Office of Nuclear Waste Management). 1 Jul 1981. 42p. NTIS, PC A03/MF A01. Order Number DE81026323.

A discussion of the relative strengths and weaknesses of the alternative forms and recommendations for future program directions are presented in the body of this report. In addition to the relative ranking, the Peer Review Panel makes the following observations and recommendations: (1) Differences in overall performance of most of the uncoated waste forms are relatively small when compared under approximately equivalent conditions. (2) The increased scientific basis for this class of waste forms has not yet been sufficient to achieve reliably large improvements in waste form performance over the best borosilicate glasses. (3) The increased leach rates at elevated temperatures and the uncertainty regarding mechanisms of leaching under repository conditions continue to indicate that surface temperatures of waste canisters and especially any waste form-water interfaces should be restricted to less than 100°C, until more data is available to indicate otherwise. (4) Improvements are noteworthy, but there is still a need for adopting additional standardized tests, standard reference materials, common units and standardized methods of data presentation in the nuclear waste program. (5) Comparative data on leach rates in waters equilibrated with candidate rocks and potential geologic environments are almost non-existent and are essential to establish relevant long term extrapolation of waste form performance.(6) Understanding radiation damage effects on the microstructure and leaching mechanisms of polycrystalline ceramics is still insufficient to judge long term reliability of this class of waste forms. (7) More extensive data on rates and mechanisms of leaching of all waste forms under radiation and repository conditions are needed. (8) Additional studies of fundamental mechanisms controlling long term reliability of glass and alternative waste forms are strongly encouraged.

28275 (DOE/UMT—0105) Engineering assessment of inactive uranium mill tailings. (Ford, Bacon and Davis Utah, Inc., Salt Lake City (USA)). Jul 1981. Contract AC04-76GJ01658. 201p. (FBDU—360-09). NTIS, PC A10/MF A01. Order Number DE81028499.

The Grand Junction site has been reevaluated in order to revise the October 1977 engineering assessment of the problems resulting from the existence of radioactive uranium mill tailings at Grand Junction, Colorado. This engineering assessment has included the preparation of topographic maps, the performance of core drillings and radiometric measurements sufficient to determine areas and volumes of tailings and radiation exposures of individuals and nearby populations, the investigations of site hydrology and meteorology, and the evaluation and costing of alternative corrective actions. Radon gas released from the 1.9 million tons of tailings at the Grand Junction site constitutes the most significant environmental impact, although windblown tailings and external gamma radiation are also factors. The eight alternative actions presented herein range from millsite and off-site decontamination with the addition of 3 m of stabilization cover material (Option I), to removal of the tailings to remote disposal sites and decontamination of the tailings site (Options II through VIII). Cost estimates for the eight options range from about $10,200,000 for stabilization in-place to about $39,500,000 for disposal in the DeBeque area, at a distance of about 35 mi, using transportation by rail. If transportation to DeBeque were by truck, the cost estimated to be about $41,900,000. Three principal alternatives for the reprocessing of the Grand Junction tailings were examined: (a) heap leaching; (b) treatment at an existing mill; and (c) reprocessing at a new conventional mill constructed for tailings reprocessing. The cost of the uranium recovered would be about $200/lb by heap leach and $150/lb by conventional plant processes. The spot market price for uranium was $25/lb early in 1981. Therefore, reprocessing the tailings for uranium recovery appears not to be economically attractive.

28276 (DOE/UMT—0105S) Summary of the engineering assessment of inactive uranium mill tailings. (Ford, Bacon and Davis Utah, Inc., Salt Lake City (USA)). Jul 1981. Contract AC04-76GJ01658. 57p. (FBDU—360-09S). NTIS, PC A04/MF A01. Order Number DE81028500.

The Grand Junction site has been reevaluated in order to revise the october 1977 engineering assessment of the problems resulting from the existence of radioactive uranium mill tailings at Grand Junction, Colorado. This engineering assessment has included the preparation of topographic maps, the performance of core drillings and radiometric measurements sufficient to determine areas and volumes of tailings and radiation exposures of individuals and nearby populations, the investigations of site hydrology and meteorology, and the evaluation and costing of alternative corrective actions. Radon gas released from the 1.9 million tons of tailings at the Grand Junction site constitutes the most significant environmental impact, although windblown tailings and external gamma radiation are also factors. The eight alternative actions presented herein range from millsite and off-site decontamination with the addition of 3 m of stabilization cover material (Option I), to removal of the tailings to remote disposal sites and decontamination of the tailings site (Option II through VIII). Cost estimates for the eight options range from about $10,200,000 for stabilization in-place to about $39,500,000 for disposal in the DeBeque area, at a distance of about 35 mi, using transportation by rail. If transportation to DeBeque were by truck, the cost is estimated to be about $41,900,000. Three prinicpal alternatives for the reprocessing of the Grand Junction tailings were examined: (a) heap leaching; (b) treatment at an existing mill; and (c) reprocessing at a new conventional mill constructed for tailings reprocessing. The cost of the uranium recovered would be about $200/lb by heap leach and $150/lb by conventional plant processes. The spot market price for uranium was $25/lb early in 1981. Therefore, reprocessing the tailings for uranium recovery appears not to be economically attractive.

28277 (DOE/UMT—0200) Evaluation of liners for a uranium-mill tailings disposal site: a status report. Buelt, J.L.; Hale, V.Q.; Barnes, S.M.; Silviera, D.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1981. Contract AC06-76RL01830. 67p. (PNL—3679). NTIS, PC A04/MF A01. Order Number DE81023671.

The United States Department of Energy is conducting a program designed to reclaim or stabilize inactive uranium-mill tailings sites. This report presents the status of the Liner Evaluation Program. The purpose of the study was to identify eight prospective lining materials or composites for laboratory testing. The evaluation was performed by 1) reviewing proposed regulatory requirements to define the material performance criteria; 2) reviewing published literature and communicating with industrial and government experts experienced with lining materials and techniques; and 3) characterizing the tailings at three of the sites for calcium concentration, a selection of anions, radionuclides, organic solvents, and acidity levels. The eight materials selected for laboratory testing are: natural soil amended with sodium-saturated montmorillonite (Volclay); locally available clay in conjunction with an asphalt emulsion radon suppression cover; locally available clay in conjunction with a multibarrier radon suppression cover; rubberized asphalt membrane; hydraulic asphalt concrete; chlorosulfonated polyethylene (hypalon) or high-density polyethylene; bentonite, sand and gravel mixture; and catalytic airblown asphalt membrane. The materials will be exposed in test units now being constructed to conditions such as wet/dry cycles, temperature cycles, oxidative environments, ion-exchange elements, etc. The results of the tests will identify the best material for field study. The status report also presents the information gathered during the field studies at Grand Junction, Colorado. Two liners, a bentonite, sand and gravel mixture, and a catalytic airblown asphalt membrane, were installed in a prepared trench and covered with tailings. The liners were instrumented and are being monitored for migration of moisture, radionuclides, and hazardous chemicals. The two liner materials will also be subjected to accelerated laboratory tests for a comparative assessment.

28278 (DP-MS—81-25) Durability of simulated waste glass: effects of pressure and formation of surface layers. Wicks, G.G.; Mosley, W.C.; Whitkop, P.G.; Saturday, K.A. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1981. Contract AC09-76SR00001. 31p. (CONF-810736—1). NTIS, PC A03/MF A01. Order Number DE81027497.

From Meeting on glass structures: surface and bulk; University Park, PA, USA (28 Jul 1981).

The leaching behavior of simulated Savannah River Plant (SRP) waste glass was studied at elevated pressures and anticipated storage temperatures. An integrated approach, which combined leachate solution analyses with both bulk and surface studies, was used to study the corrosion process. Compositions of leachates were evaluated by colorimetry and atomic absorption. Used in the bulk and surface analyses were optical microscopy, scanning electron microscopy, x-ray energy spectroscopy, wide-angle x-ray, diffraction, electron microprobe analysis, infrared reflectance spectroscopy, electron spectroscopy for chemical analysis, and Auger electron spectroscopy. Results from this study show that there is no significant adverse effect of pressure, up to 1500 psi and 90°C, on the chemical durability of simulated SPR waste glass leached for one month in deionized water. In addition, the leached glass surface layer was characterized by an adsorbed film rich in minor constituents from the glass. This film remained on the glass surface even after leaching in relatively alkaline solutions at elevated pressures at 90°C for one month. The sample surface area to volume of leachant ratios (SA/V) was 10:1 cm^{-1} and 1:10 cm^{-1}. The corrosion mechanisms and surface and subsurface layers produced will be discussed along with the potential importance of these results to repository storage.

28279 (DPST—80-203) Process arrangement options for Defense waste immobilization. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Feb 1980. Contract AC09-76SR00001. 209p. NTIS, PC A10/MF A01. Order Number DE81027017.

Current plans are to immobilize the SRP high-level liquid wastes in a high integrity form. Borosilicate glass was selected in 1977 as the reference waste form and a mjaor effort is currently underway to develop the required technology. A large new facility, referred to as the Defense Waste Processing Facility (DWPF) is being designed to carry out this mission, with project authorization targeted for 1982 and plant startup in 1989. However, a number of other process arrangements or manufacturing strategies, including staging the major elements of the project or using existing SRP

facilities for some functions, have been suggested in lieu of building the reference DWPF. This study assesses these various options and compares them on a technical and cost basis with the DWPF. Eleven different manufacturing options for SRP defense waste solidification were examined in detail. These cases are: (1) vitrification of acid waste at current generation rate; (2) vitrification of current rate acid waste and caustic sludge; (3 and 4) vitrification of the sludge portion of neutralized waste; (5) decontamination of salt cake and storage of concentrated cesium and strontium for later immobilization; (6) processing waste in a facility with lower capacity than the DWPF; (7) processing waste in a combination of existing and new facilities; (8) waste immobilization in H Canyon; (9) vitrification of both sludge and salt; (10) DWPF with onsite storage; (11) deferred authorization of DWPF.

28280 **(DPST—80-410-Rev.1) Disposal of DWPF salt product.** (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 30 May 1980. Contract AC09-76SR00001. 7p. NTIS, PC A02/MF A01. Order Number DE81028766.

This letter describes the reference process chosen from the options for the Defense Waste Processing Facility (DWPF) salt disposal and some of its alternatives which are also being considered for the DWPF environmental impact statement. The reference process calls for immobilizing the salt in concrete and burying the salt-crete onsite at depths of 10 meters or greater inside of low-permeability clay barriers. This process is calculated to provide a high level of biological protection, to meet all current federal and state regulations, and to provide a relatively low cost solution to the disposal of the processed waste salt. An extensive program is underway to optimize the salt-crete product and the burial conditions and to demonstrate compliance with the still developing environmental regulations. Alternatives which are being considered to this process for the EIS include: (1) return of the DWPF product salt to existing SRP waste tanks without further processing; (2) return of the DWPF product salt to existing (or new) SRP waste tanks in saltcrete form; (3) offsite shipment of the DWPF product salt for geologic disposal; (4) burial of nondecontaminated salt at SRP as saltcrete (not included in EIS); and (5) indefinite storage of nondecontaminated salt in existing SRP waste tanks (no action case).

28281 **(DPSTD—80-39) Preliminary technical data summary defense waste processing facility stage 2.** (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Dec 1980. Contract AC09-76SR00001. 288p. NTIS, PC E11/MF $5.50. Order Number DE81027015.

Includes 14 sheets of 48x reduction microfiche.

This Preliminary Technical Data Summary presents the technical basis for design of Stage 2 of the Staged Defense Waste Processing Facility (DWPF). Process changes incorporated in the staged DWPF relative to the Alternative DWPF described in PTDS No. 3 (DPSTD-77-13-3) are the result of ongoing research and development and are aimed at reducing initial capital investment and developing a process to efficiently immobilize the radionuclides in Savannah River Plant (SRP) high-level liquid waste. The radionuclides in SRP waste are present in sludge that has settled to the bottom of waste storage tanks and in crystallized salt and salt solution (supernate). Stage 1 of the DWPF receives washed, aluminum dissolved sludge from the waste tank farms and immobilizes it in a borosilicate glass matrix. The supernate is retained in the waste tank farms until completion of Stage 2 of the DWPF at which time it is filtered and decontaminated by ion exchange in the Stage 2 facility. The decontaminated supernate is concentrated by evaporation and mixed with cement for burial. The radioactivity removed from the supernate is fixed in borosilicate glass along with the sludge. This document gives flowsheets, material and curie balances, material and curie balance bases, and other technical data for design of Stage 2 of the DWPF. Stage 1 technical data are presented in DPSTD-80-38.

28282 **(EGG-FM—5366) TRU waste form studies with special reference to iron-enriched basalt: 1980. Annual report.** Flinn, J.E.; Henslee, S.P.; Kelsey, P.V. Jr. (EG and G Idaho, Inc., Idaho Falls (USA)). Jun 1981. Contract AC07-76ID01570. 299p. NTIS, PC A13/MF A01. Order Number DE81028274.

Material studies were performed on iron-enriched basalt (IEB) as a waste form containment medium for transuranic wastes. Specimens from laboratory scale, as well as large scale melts, were used in the evaluation. The studies included melting and casting, slag-refractory interaction, slag fruit assessments, volatility of sodium salts from IEB melts, chemical and structure homogeneity, metallic dissolution tests, physical properties, and devitrification associated with the development of mineral phases. In addition, durability tests, which included leaching and mechanical behavior, were performed.

28283 **(HEDL—6799) HEDL contribution to Office of Nuclear Waste Isolation. May monthly report.** Cantley, D.A.; Knecht, R.L. (Hanford Engineering Development Lab., Richland, WA (USA)). 18 Jun 1980. Contract AC14-76FF02170. 6p. NTIS, PC A02/MF A01. Order Number DE81026481.

Progress is reported in the following areas of study: spent fuel characterization equipment; spent fuel characterization; and spent fuel/package performance. Some of the highlights are: calorimetry of Turkey Point Assembly D04 subsequently emplaced in the Climax-Spent Fuel Test (C-SFT) was completed; all data from the destructive examination of five fuel rods pulled from the C-SFT assemblies are being reduced and analyzed to provide a description of the pre-test condition for the C-SFT; work is continuing on the development of a one-dimensional fuel assembly structural analyses code; sensitivity studies of fuel assembly response to grid spacer moment shear coupling terms and guide tube locations and quantity were completed; verification of STAFF-5, the two-dimensional heat transfer-fluid flow-stress model of a spent fuel assembly in a canister is continuing; Whole Rod Tests 1 at 950°F and 2b at 1060°F continue to operate without cladding breach; destructive examination and fission gas analyses on the two rods removed from Test 2b were completed; evaluation of the spent fuel filler materials thermal performance was completed; the metal alloys and graphite offered the most favorable heat transfer characteristics; both thermal gradient and differential thermal expansion effects on the mechanical behavior of the spent fuel filler system are being evaluated.

28284 **(HEDL—6888) HEDL contribution to Office of Nuclear Waste Isolation. July through September quarterly report: spent fuel characterization equipment.** Cash, R.J. (Hanford Engineering Development Lab., Richland, WA (USA)). 15 Oct 1980. Contract AC14-76FF02170. 10p. NTIS, PC A02/MF A01. Order Number DE81026483.

Progress reports are presented for the following areas of study: spent fuel characterization equipment; spent fuel characterization; and spent fuel/package performance. Some of the highlights are: calorimetry was performed on spent fuel assemblies D15 and D22 which were destined for packaging and emplaced into the Climax-Spent Fuel Test (C-SFT); review and analysis of the destructive examination data on five fuel rods pulled from the C-SFT assemblies is continuing; under the disposal condition loads assumed in the structural analyses. The spent fuel cladding has very high mechanical integrity; a program plan to develop a spent fuel data base and predict the in-respository performance of spent fuel is being prepared; documentation was completed describing the test capsule hardware, specimens, safety analysis, and as-built assembly for the Climax-Materials Interaction Test; gamma dose calculations for 30 spent fuel canister filler materials were completed and documented; in support of the stabilizer material screening effort, all preliminary interaction, cost, and availability evaluations were completed; detailed planning for temperature limit, fill process, and prebreach disposal condition compatibility testing was completed.

28285 **(HEDL—6889) HEDL contribution to ONWI, September monthly report: spent fuel characterization.** Cash, R.J. (Hanford Engineering Development Lab., Richland, WA (USA)). 15 Oct 1980. Contract AC14-76FF02170. 4p. NTIS, PC A02/MF A01. Order Number DE81026484.

Progress reports are presented for the following areas of investigation: spent fuel characterization equipment; spent fuel characterization; and spent fuel/package performance. The following are some of the accomplishments. The Pacific Northwest Laboratory (PNL) compilation of calorimetry design and operational information was reviewed by HEDL and returned to PNL for revi-

sion incorporating comments. Analysis of data and preparation of final documentation on the destructive examination of spent fuel rods from assemblies used in the Climax - Spent Fuel Test continued. A final loading basis representing seismic and transportation events was established for input to the structural models. The resultant stress histories were applied to cladding fatigue-fracture models. Results show high cladding integrity under the applied loading. The study, A Perspective on Fission Gas Release From Spent Fuel Rods During Geologic Disposal, was completed. Verification documentation was completed for the STAFF-5 heat transfer-fluid flow-stress model of a spent LWR fuel assembly for storage/disposal configurations. Nondestructive examination of the rods removed from whole rod Test No. 1 at 510°C and Test No. 2b at 571°C was completed. The program plan for testing spent fuel degradation mechanisms was completed. the initial work scope for the alternate Waste Form Assessment was formulated. In support of the Spent Fuel Stabilizer Program, work continued in preparation for prebreach tests.

28286 **(HEDL—6921) Office of Nuclear Waste Isolation: HEDL stabilizer materials program, October-December quarterly report.** Fish, R.L.; Cash, R.J. (Hanford Engineering Development Lab., Richland, WA (USA)). 15 Dec 1981. Contract AC14-76FF02170. 8p. NTIS, PC A02/MF A01. Order Number DE81026499.

The objective of the Spent Fuel Stabilizer Materials Program is to identify, test, select, and qualify stabilizer materials for use in the design of spent fuel waste packages. Emphasis is placed on the selection of stabilizer materials with minimal interactions. The preliminary screening of candidate spent fuel stabilizer materials was completed and reported to the Office of Nuclear Waste Isolation in November 1980. Based on criteria set for thermally induced stresses, material cost, and material availability, an initial list of potential stabilizers was reduced to 34 that are recommended for additional screening tests. The spent fuel stabilizer temperature limit test was completed during this report period. Tests were conducted to establish a conservative temperature limit for spent light water reactor (LWR) fuel during the stabilizer emplacement process. Melting of metals and metal alloys, fusing of glass stabilizers,or other possible emplacement processes may require elevation of the spent fuel temperature above levels desirable for maintaining fuel rod integrity (intact cladding) or reasonable inter-rod spacing for stabilizer flow. This test was conducted to establish the temperature below which these concerns would not exist. Stabilizers that require emplacement process temperatures above the limit will be eliminated from the screening program.

28287 **(HEDL—6922) Office of Nuclear Waste Isolation - spent-fuel-characterization program - October-December revised quarterly report.** Cash, R.J. (Hanford Engineering Development Lab., Richland, WA (USA)). 14 Feb 1981. Contract AC14-76FF02170. 6p. NTIS, PC A02/MF A01. Order Number DE81026500.

The Waste Form Assessment task is evaluating the relative in-repository performance of five waste forms, especially their ability to retard the release of radionuclides. In order to reduce these basic waste form variations to a series of well-defined cases, a matrix was developed incorporating all significant variables. Construction of this matrix produced a total of 13 combinations of system variables. These 13 combinations are under evaluation for prebreach and post-breach performance relative to criteria for support aginst lithostatic pressure, long-term stability for radionuclide retention, minimization of cladding degradation, breach of the canister by possible gas pressurization, heat transfer, and criticality. Performance of each of the 13 waste form/stabilizer combinations for four temperature ranges is also being evaluated. Spent fuel characterization and degradation studies initiated this quarter have identified surface area, surface structure, grain boundary conditions, fission product positions, fuel phases, and valence states as important fuel characteristics which might significantly influence the dissolution and leaching rates of radionuclides. An analysis of prepressurization gas and fission gas release from spent fuel during geologic disposal was completed. Based on a typical proposed canister and repository design, even under worst case, highly improbable release scenarios, gas pressurization presents no harmful effects to the waste form, package or repository. Fuel assembly structural and fracture mechanics analyses of spent fuel under disposal cycle dynamic loading conditions were completed. Results show negligible damage to spent fuel assemblies because the resulting stresses are low under normal expected transportation and disposal cycle conditions.

28288 **(HEDL—6956) HEDL contribution to ONWI: HEDL stabilizer materials program, January through March quarterly report, 1981.** Fish, R.L.; Cash, R.J. (Hanford Engineering Development Lab., Richland, WA (USA)). 15 Apr 1981. Contract AC14-76FF02170. 7p. NTIS, PC A02/MF A01. Order Number DE81026495.

The objective of the Spent Fuel Stabilizer Materials Program is to identify, test, select, and qualify stabilizer materials for use in the design of spent fuel waste packages. Emphasis is placed on the selection of stabilizer materials that exhibit minimal interaction with the other waste package components. The spent fuel stabilizer fill process screening test was completed. This test measured the interaction of candidate metal stabilizers with LWR fuel cladding during stabilizer emplacement at elevated temperatures. While the test focused on screening of stabilizer materials, interaction information with a candidate canister material (1018 carbon steel) was also generated and will be useful in future considerations.

28289 **(HEDL—6960) HEDL contribution to ONWI spent fuel characterization program. Quarterly report, January-March, 1981.** Cash, R.J. (Hanford Engineering Development Lab., Richland, WA (USA)). 1981. Contract AC14-76FF02170. 4p. NTIS, PC A02/MF A01. Order Number DE81026496.

Five spent fuel waste forms were analyzed for relative in-repository performance. In order to evaluate the waste form/stabilizer combinations, their performance in terms of possible functional requirements was assessed. These included: (1) Waste Form/Stabilizer Support Against Lithostatic Pressure; (2) Long-Term Stability for Radionuclide Retention; (3) Minimization of Cladding Degradation; (4) Prevention of Canister/Repository Breach Due to Pressurization; (5) Stabilizer Heat Transfer; (6) The Stabilizer as an Independent Barrier to Radionuclide Migration; and (7) Prevention of Criticality. Three stabilizers were considered: inert gas, particulate and solid. Based on the conclusions of the rating of the waste forms, the relative performance of the waste forms dictates that the candidates be ordered as follows: (1) The best waste form/stabilizer combination is the intact assembly, with or without end bells, vented or unvented, with a solid stabilizer. (2) A suitable alternative is the combination of bundled close-packed rods with a solid stabilizer around the outside of the bundle to resist lithostatic pressure. (3) The other possible waste forms are of lower ranking with the worst waste form/stabilizer combination being the intact assembly with a gas stabilizer or the chopped fuel. Long-term degradation of fuel residing in a repository was studied as part of the Spent Fuel Degradation task. It was concluded that in intact fuel volatile fission product migration, fragmentation and radiation damage would not take place to any extent that could damage the fuel. The study concluded that cladding integrity should be preserved since fuel exposed to the canister environment may undergo major thermodynamic changes which cannot be analyzed with the current state of knowledge.

28290 **(K/ET—5028) Cement fixation variable study.** McGinnis, C.P.; Morris, J.S.; Housley, D.A. (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). 6 Jul 1981. Contract W-7405-ENG-26. 34p. NTIS, PC A03/MF A01. Order Number DE81027611.

Cement fixation was the method of choice for the ORGDP waste sludge. This report covers an experimental design conducted to determine the effects of eleven variables on the low strength concrete to be used as the primary fixation method at the ORGDP Central Solidification Facility. Discussions on variable selection, the experimental design, statistical treatment of results and current efforts are presented.

28291 **(LA—8845-MS) Geology and petrology of the basalts of Crater Flat: applications to volcanic risk assessment for the Nevada Nuclear Waste Storage investigations.** Vaniman, D.; Crowe, B. (Los Alamos National Lab., NM (USA)). Jun 1981. Contract W-7405-ENG-36. 68p. NTIS, PC A04/MF A01. Order Number DE81026682.

Volcanic hazard studies of the south-central Great Basin, Nevada, are being conducted for the Nevada Nuclear Waste Storage Investigations. This report presents the results of field and petrologic studies of the basalts of Crater Flat, a sequence of Pliocene to Quaternary-age volcanic centers located near the southwestern part of the Nevada Test Site. Crater Flat is one of several basaltic fields constituting a north-northeast-trending volcanic belt of Late Cenozoic age extending from southern Death Valley, California, through the Nevada Test Site region to central Nevada. The basalts of Crater Flat are divided into three distinct volcanic cycles. The cycles are characterized by eruption of basalt magma of hawaiite composition that formed cinder cone clusters and associated lava flows. Total volume of erupted magma for respective cycles is given. The basalts of Crater Flat are sparsely to moderately porphyritic; the major phenocryst phase is olivine, with lesser amounts of plagioclase, clinopyroxene, and rare amphibole. The consistent recurrence of evolved hawaiite magmas in all three cycles points to crystal fractionation from more primitive magmas at depth. A possible major transition in mantle source regions through time may be indicated by a transition from normal to Rb-depleted, Sr-enriched hawaiites in the younger basaltic cycles. The recurrence of small volumes of hawaiite magma at Crater Flat supports assumptions required for probability modeling of future volcanic activity and provides a basis for estimating the effects of volcanic disruption of a repository site in the southwestern Nevada Test Site region. Preliminary data suggest that successive basalt cycles at Crater Flat may be of decreasing volume but recurring more frequently.

28292 **(LA—8850-PR) Natural repository analouge program. Progress report, January 1-March 31, 1981.** Curtis, D.B. (comp.). (Los Alamos National Lab., NM (USA)). May 1981. Contract W-7405-ENG-36. 21p. NTIS, PC A02/MF A01. Order Number DE81026810.

Samples from Oklo Reactor zone-9 (ORZ-9) have been analyzed for the isotopic abundances of Nd, Ce, Ru, and Mo. Interpretation of the Nd data has begun as part of the effort to reconstruct the operating parameters of the reactor. The study of ORZ-9 and the peripheral rocks is being enhanced by additional analytical capabilities. A procedure was developed to measure uranium isotopic ratios with high precision. This new method was used for the analysis of rocks peripheral to ORZ-9. Two rocks containing relatively small quantities of uranium were depleted in ^{235}U. The result demonstrates that small quantities of uranium were removed from the reactor zone and redistributed over distances of several tens of meters. Procedures are being designed to make high precision measurements of the relative abundances of barium isotopes. They will be used as part of a study of the transport of alkali and alkaline earth elements at Oklo. Samples from distances up to 300 meters from the known mineralized area at Oklo have been selected and prepared in an effort to identify element transport paths over longer distances. A sample from the Athabasca sandstone, overlying the uranium ores at Key Lake, and another from the transition zone at the unconfromity between the sandstone and the basement were subjected to sequential leaches designed to preferentially dissolve specific minerals. Lead isotopic analyses on the leachs yielded two sets of data, which indicate the loss of uranium or the addition of lead from a radiogenic source early in the geologic history of the rocks.

28293 **(ONWI—9/81-1) Technical progress report for the quarter 1 October-31 December 1980.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). 1981. Contract AC06-76RL01830. 340p. NTIS, PC A15/MF A01. Order Number DE81025481.

This report describes the technical accomplishments on the commercial nuclear waste management programs and on the geologic disposal of nuclear wastes. The program is organized into eight tasks: systems, waste package, site, repository, regulatory and institutional, test facilities and excavations, land acquisition, and program management. (DLC)

28294 **(ONWI—208) Thermal gradient migration of brine inclusions in salt.** Olander, D.R.; Machiels, A.J.; Yagnik, S. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; California Univ., Berkeley (USA). Coll. of Engineering). Oct 1980. Contract AC06-76RL01830. 99p. NTIS, PC A05/MF A01. Order Number DE81027535.

A detailed heat and mass transport model of the migration of gas-liquid inclusions in salt was developed and compared with available experimental data. Generally good agreement was obtained, but the theory was consistently somewhat high. An advanced model which includes interface kinetics and surface tension-driven convection was developed to improve the earlier theory. An apparatus consisting of an optical microscope with a hot-stage attachment capable of simultaneously mechanically loading small, single-crystal specimens of salt and applying a temperature gradient was constructed. The apparatus was used to measure the velocities of all-liquid inclusions under various conditions of temperature, temperature gradient, and uniaxial stress. The primary rate-controlling elementary step in the migration of small all-liquid inclusions in single crystals of alkali halides was identified as dissolution of the hot face. Dislocations are required for this step to take place. The small number of dislocation intersections with small inclusions in nearly perfect crystals causes substantial variations in the velocity, a sensitivity of the velocity to mechanical loading of the crystal, and a velocity which varies approximately as the square of the temperature gradient.

28295 **(ONWI—218Vol.1) Recommended waste handling operations and equipment.** Kingsbury, R.J.; Monaghan, D.A. (Los Alamos Technical Associates, Inc., NM (USA)). Sep 1980. Contract AC06-76RL01830. 222p. NTIS, PC A10/MF A01. Order Number DE81026667.

Recommended waste handling operations and equipment were developed for the National Waste Terminal Storage geologic repositories. The concepts, approaches, and criteria developed are based on existing conceptual designs for repositories and descriptions of similar systems in other nuclear waste management programs. Detailed reviews of the conceptual designs for repositories in bedded and dome salt formations were performed to establish and characterize the waste flow paths through the repositories; identify the systems, subsystems, and components of the flow paths; and identify waste handling system similarities and differences. Alternatives to waste handling operations and equipment have been identified and evaluated for overall suitability in relation to a comprehensive set of evaluation parameters. The recommended waste handling operations have been incorporated into flow diagrams supplemented by equipment design and performance criteria. Individual components have also been assigned appropriate quality assurance levels based on a consequence-of-failure analysis. The results of this study are recommended operations and equipment for canistered and low-level waste handling systems. These results may be used as design bases and criteria for future repository design activities. Numerous advantages over existing designs have resulted from this study. Volume I contains the following: executive summary; recommended operations and equipment; technical approach; and appendix A - operations and equipment data sheets.

28296 **(ONWI—218Vol.2) Recommended waste handling operations and equipment.** Kingsbury, R.J.; Monaghan, D.A. (Los Alamos Technical Associates, Inc., NM (USA)). Sep 1980. Contract AC06-76RL01830. 170p. NTIS, PC A08/MF A01. Order Number DE81026666.

Recommended waste handling operations and equipment were developed for the National Waste Terminal Storage geologic repositories. Detailed reviews of the conceptual designs for repositories in bedded and dome salt formations were performed to establish and characterize the waste flow paths through the repositories; identify the systems, subsystems, and components of the flow paths; and identify waste handling system similarities and differences. The results of this study are recommended operations and equipment for canistered and low-level waste handling systems. These results may be used as design bases and criteria for future repository design activities. Numerous advantages over existing designs have resulted from this study. Volume II consists of appendix B - conceptual design report review data.

28297 (ONWI—218Vol.3) Rcommended waste handling operations and equipment. Kingsbury, R.J.; Monaghan, D.A. (Los Alamos Technical Associates, Inc., NM (USA)). Sep 1980. Contract AC06-76RL01830. 236p. NTIS, PC A11/MF A01. Order Number DE81026665.

Recommended waste handling operations and equipment were developed for the National Waste Terminal Storage geologic repositories. Detailed reviews of the conceptual designs for repositories in bedded and dome salt formations were performed to establish and characterize the waste flow paths through the repositories; identify the systems, subsystems, and components of the flow paths; and identify waste handling system similarities and differences. The results of this study are recommended operations and equipment for canistered and low-level waste handling systems. These results may be used as design bases and criteria for future repository design activities. Numerous advantages over existing designs have resulted from this study. Volume III has appendix C - operational flow diagrams.

28298 (ONWI—218Vol.4) Recommended waste handling operations and equipment. Kingsbury, R.J.; Monaghan, D.A. (Los Alamos Technical Associates, Inc., NM (USA)). Sep 1980. Contract AC06-76RL01830. 314p. NTIS, PC A14/MF A01. Order Number DE81026664.

Recommended waste handling operations and equipment were developed for the National Waste Terminal Storage geologic repositories. Detailed reviews of the conceptual designs for repositories in bedded and dome salt formations were performed to establish and characterize the waste flow paths through the repositories; identify the systems, subsystems, and components of the flow paths; and identify waste handling system similarities and differences. The results of this study are recommended operations and equipment for canistered and low-level waste handling systems. These results may be used as design bases and criteria for future repository design activities. Numerous advantages over existing designs have resulted from this study. Volume IV contains appendices on operations comparisons, alternative selection, alternatives evaluation parameters, alternatives evaluation and consequence of failure analysis.

28299 (ORNL/ENG/TM—22) Krypton-85 hydrofracture engineering feasibility and safety evaluation. Peretz, F.J.; Muller, M.E.; Pan, P.Y. (Oak Ridge National Lab., TN (USA); Los Alamos Technical Associates, Inc., NM (USA)). Jul 1981. Contract W-7405-ENG-26. 196p. NTIS, PC A09/MF A01. Order Number DE81027444.

Engineering studies have been made to determine the hazards associated with the disposal of ^{85}Kr using the hydrofracture process. To assess the hazards, an effort has been made to identify the equipment required to entrain and dissolve the noble gas into the grout stream at hydrofracture pressure (up to 350 bar). Off-the-shelf or slightly modified equipment has been identified for safe and effective compression and gas-grout mixing. Each monthly injection disposes of 1.6 x 10^6 Ci of ^{85}Kr. By connecting only one gas cylinder to the injection system at a time, the maximum amount of krypton likely to be released as a result of equipment failure is limited to 128,000 Ci. An evaluation by Los Alamos Technical Associates shows that releasing this amount of gas in less than one hour under worst-case meteorological conditions through a 30-m stack would result in a whole-body dose of 170 millirem at a distance of 1 km from the facility. A krypton collection and recovery system can further reduce this dose to 17 millirem; increasing the distance to the site boundary to 3 km can also reduce the dose by a factor of ten. Lung and skin dose estimates are 1.6 and 120 times the whole-body dose, respectively. These are all worst-case values; releases under more typical conditions would result in a significantly lower dose. No insurmountable safety or engineering problems have been identified.

28300 (ORNL/TM—7693) Carbon-14 immobilization via the CO_2-$Ba(OH)_2$ hydrate gas-solid reaction. Haag, G.L. (Oak Ridge National Lab., TN (USA)). Aug 1981. Contract W-7405-ENG-26. 38p. NTIS, PC A03/MF A01. Order Number DE81029105.

For the treatment of an air-based off-gas stream, the use of packed beds of $Ba(OH)_2.8H_2O$ flakes to remove CO_2 has been demonstrated. However, the operating conditions must be maintained between certain upper and lower limits with respect to the partial pressure of water. If the water vapor pressure in the gas is less than the dissociation vapor pressure of $Ba(OH)_2.8H_2O$, the bed will deactivate. If the vapor pressure is considerably greater, pressure drop problems will increase with increaseing humidity as the particles curl and degrade. Results have indicted that when operated in the proper regime, the bulk of the increase in pressure drop results from the conversion of $Ba(OH)_2.8H_2O$ to $BaCO_3$ and not from the hydration of the commercial $Ba(OH)_2.8H_2O$ (i.e., $Ba(OH)_2.7.50H_2O$) to $Ba(OH)_2.8H_2O$.

28301 (ORNL/TM—7770) Materials considerations relative to multibarrier waste isolation. McCoy, H.E.; Griess, J.C. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 34p. NTIS, PC A03/MF A01. Order Number DE81029104.

The environmental conditions associated with the storage of radioactive wastes are reviewed, and the corrosion of potential waste containment materials under these conditions is evaluated. The desired service life of about 1000 years is beyond the time period for which existing corrosion data can be extrapolated with certainty; however, titanium alloys seem to offer the most promise. The mechanical requirements for canisters and overpacks are considered and several candidate materials are selected. Designs for a canister and an overpack have been developed, and these are used to estimate the costs for three possible materials of construction.

28302 (PNL—3356) Analysis on the use of engineered barriers for geologic isolation of spent fuel in a reference salt site repository. Cloninger, M.O.; Cole, C.R.; Washburn, J.F. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1980. Contract AC06-76RL01830. 254p. NTIS, PC A12/MF A01. Order Number DE81027620.

A perspective on the potential durability and effectiveness requirements for the waste form, container and other engineered barriers for geologic disposal of spent nuclear fuel has been developed. This perspective is based on calculated potential doses to individuals who may be exposed to radioactivity released from a repository via a groundwater transport pathway. These potential dose commitments were calculated with an integrated geosphere transport and bioshpere transport model. A sensitivity analysis was accomplished by varying four important system parameters, namely the waste radionuclide release rate from the repository, the delay prior to groundwater contact with the waste (leach initiation), aquifer flow velocity and flow path length. The nuclide retarding capacity of the geologic media, a major determinant of the isolation effectiveness, was not varied as a parameter but was held constant for a particular reference site. This analysis is limited to looking only at engineered barriers whose net effect is either to delay groundwater contact with the waste form or to limit the rate of release of radionuclides into the groundwater once contact has occurred. The analysis considers only leach incident scenarios, including a water well intrusion into the groundwater near a repository, but does not consider other human intrusion events or catastrophic events. The analysis has so far been applied to a reference salt site repository system and conclusions are presented.Basically, in nearly all cases, the regional geology is the most effective barrier to release of radionuclides to the biosphere; however, for long-lived isotopes of carbon, technetium and iodine, which were poorly sorbed on the geologic media, the geology is not very effective once a leach incident is initiated.

28303 (PNL—3542) Geologic simulation model for a hypothetical site in the Columbia Plateau. Petrie, G.M.; Zellmer, J.T.; Lindberg, J.W.; Foley, M.G. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Apr 1981. Contract AC06-76RL01830. 603p. NTIS, PC A99/MF A01. Order Number DE81027687.

This report describes the structure and operation of the Assessment of Effectiveness of Geologic Isolation Systems (AEGIS) Geologic Simulation Model, a computer simulation model of the geology and hydrology of an area of the Columbia Plateau, Washington. The model is used to study the long-term suitability of the Columbia Plateau Basalts for the storage of nuclear waste in a mined repository. It is also a starting point for analyses of such repositories in other geologic settings. The Geologic Simulation

Model will aid in formulating design disruptive sequences (i.e. those to be used for more detailed hydrologic, transport, and dose analyses) from the spectrum of hypothetical geological and hydrological developments that could result in transport of radionuclides out of a repository. Quantitative and auditable execution of this task, however, is impossible without computer simulation. The computer simulation model aids the geoscientist by generating the wide spectrum of possible future evolutionary paths of the areal geology and hydrology, identifying those that may affect the repository integrity. This allows the geoscientist to focus on potentially disruptive processes, or series of events. Eleven separate submodels are used in the simulation portion of the model: Climate, Continental Glaciation, Deformation, Geomorphic Events, Hydrology, Magmatic Events, Meteorite Impact, Sea-Level Fluctuations, Shaft-Seal Failure, Sub-Basalt Basement Faulting, and Undetected Features. Because of the modular construction of the model, each submodel can easily be replaced with an updated or modified version as new information or developments in the state of the art become available. The model simulates the geologic and hydrologic systems of a hypothetical repository site and region for a million years following repository decommissioning. The Geologic Simulation Model operates in both single-run and Monte Carlo modes.

28304 **(PNL—3881) Summary of non-US national and international radioactive waste management programs 1981.** Harmon, K.M.; Kelman, J.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1981. Contract AC06-76RL01830. 78p. NTIS, PC A05/MF A01. Order Number DE81026978.

Many nations and international agencies are working to develop improved technology and industrial capability for neuclear fuel cycle and waste management operations. The effort in some countries is limited to research in university laboratories on treating low-level waste from reactor plant operations. In other countries, national nuclear research institutes are engaged in major programs in all phases of the fuel cycle and waste management, and there is a national effort to commercialize fuel cycle operations. Since late 1976, staff members of Pacific Northwest Laboratory have been working under US Department of Energy sponsorship to assemble and consolidate openly available information on foreign and international nuclear waste management programs and technology. This report summarizes the information collected on the status of fuel cycle and waste management programs in selected countries making major efforts in these fields as of the end of May 1981.

28305 **(RHO-BWI-SA—76) Reference physicochemical conditions in a nuclear waste repository situated in Columbia River basalt.** Coons, W.E. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Oct 1980. Contract AC06-77RL01030. 8p. (CONF-801124—52). NTIS, PC A02/MF A01. Order Number DE81026587.

From 3. annual meeting of the Materials Research Society; Boston, MA, USA (17 Nov 1980).

Field measurements and thermodynamic calculations have been used to define conditions existing in the present geologic environment. These conditions are appropriate to late repository history when perturbations caused by waste burial have subsided. Experimental measurements and additional calculations have been used to predict the repository environment as it will be during the thermal period. A wider range in physicochemical conditions will occur in the thermal period than will be obtained during geologic control because of thermal and kinetic effects. For easy reference, equilibrium conditions for a closed repository are summarized. These values have been calculated at a series of temperatures.

28306 **(RHO-BWI-SA—81) Analysis of fracture flow and transport in the near-field zone of a nuclear waste repository.** Baca, R.G.; Arnett, R.C. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). 1981. Contract AC06-77RL01030. 11p. (CONF-810372—4). NTIS, PC A02/MF A01. Order Number DE81026579.

From Symposium on uncertainties associated with the regulation of the geologic disposal of high-level radioactive waste; Gatlinburg, TN, USA (9 Mar 1981).

Numerical models were recently developed for use in modeling the near-field processes in fractured-porous rock systems. The theoretical framework of the models is based on a continuum description of rock mass and Darcian flow concepts. Groundwater flow is related to the rock stress state and thermal regime through the effects on hydraulic conductivity and buoyancy. Heat transport through the water-rock system is modeled in a coupled manner accounting for processes of convection, dispersion, conduction, and thermal energy sources. The variations in the rock stress state are related to the temperature patterns in the near-field zone. The complete set of model equations are solved using a finite element numerical method. Parametric and sensitivity modeling studies have been performed in evaluating the waste isolation capability of a hypothetical repository in basalt media. Analysis of various hydrologic release scenarios has been performed. In this paper, simulation results are presented which estimate the time-dependent response of a basalt waste isolation system over a 30,000-year period. Calculations of particle pathlines and travel times are presented in conjunction with nuclide transport patterns.

28307 **(RHO-BWI-SA—90) Corrosion tests of canister and overpack materials in simulated basalt groundwater.** Anderson, W.J. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). 1981. Contract AC06-77RL01030. 12p. (CONF-810217—18). NTIS, PC A02/MF A01. Order Number DE81026189.

From ANS waste management conference; Tucson, AZ, USA (23 Feb 1981).

Preliminary results indicate that the environment expected in a repository in basalt is not highly corrosive to the materials tested. Comparisons of weight change data between two simulated basalt groundwater compositions indicate that variations in oxygen fugacity had a minor effect on corrosion of nickel, titanium, and zirconium alloys. The corrosion of cupronickel alloy, however, was drastically reduced when a lower oxygen fugacity was maintained. Effectiveness of a hydrogen/argon sparge to maintain a low oxygen fugacity in a simulated groundwater was demonstrated. 5 tables.

28308 **(RHO-BWI-SA—113) Numerical modeling of flow and transport processes in a fractured-porous rock system.** Baca, R.G.; Arnett, R.C.; King, I.P. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations; Resource Management Associates, Lafayette, CA (USA)). 1981. Contract AC06-77RL01030. 7p. (CONF-810624—10). NTIS, PC A02/MF A01. Order Number DE81025972.

From 22. US symposium on rock mechanics; Cambridge, MA, USA (29 Jun 1981).

The feasibility of using underground repositories for terminal waste storage depends on the basic isolation capability of the candidate geologic medium. In the case of a hardrock geology, such as basalt, the degree of waste isolation will be determined by the response of the water-rock system to both natural and repository-induced perturbations. Numerical models capable of describing hydrological and geomechanical processes provide a basis for assesssing the waste isolation performance of the host medium. Numerical models were recently developed for specific use in modeling the near-field processes in fractured-porous rock systems. Transport of heat through the water-rock system is modeled in a fully coupled manner with groundwater flow. Migration of dissolved nuclides is modeled by accounting for the transport processes of advection, dispersion/diffusion, sorption, and chain decay. A Galerkin finite-element approach is used in conjunction with a Newton-Raphson method to solve the set of governing equations. The numerical models were recently applied in a parametric and sensitivity modeling study to evaluate the basic waste isolation characteristics of the Columbia River basalts beneath the Hanford Site, near Richland, Washington. In this paper, selected simulation results are presented which show the time-dependent response of the basalt waste isolation system over long-term periods.

28309 **(RHO-BWI-SA—145) Development and testing of waste package backfill materials for a nuclear waste repository located in basalt.** Wood, M.I. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). 1981. Contract AC06-77RL01030. 20p. (CONF-810499—1). NTIS, PC A02/MF A01. Order Number DE81025238.

From National Bureau of Standards workshop of R and D needs in backfill for nuclear waste repositories; Gaithersburg, MD, USA (13 Apr 1981).

A deep repository located in Hanford basalt has been proposed for the disposal of high-level nuclear waste. Backfill materials are required to make up the backfill component of a multiple barrier waste package and to fill the rooms, tunnels, and shafts of the repository sealing system. The major emphasis of this paper is the backfill component of the waste package. However, much of the discussion is applicable to the repository sealing system. The functions, material properties, candidate materials, and testing methods for backfill are discussed. Because of the variety of backfill functions, physical, mechanical, and chemical properties are required of an adequate backfill. Therefore, a multicomponent backfill will probably be needed. The geochemical environment of the basalt site and the physical and chemical reactions that are likely to occur in the near-field environment have been used to derive the essential testing needs. 4 tables.

28310 **(RHO-SA—155-Rev.1) Hanford Site sorption studies for the control of radioactive wastes: a review.** Routson, R.C.; Barney, G.S.; Smith, R.M. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Dec 1980. Contract AC06-77RL01030. 23p. (CONF-800607—96). NTIS, PC A02/MF A01. Order Number DE81026009.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

Past and present sorption studies at Hanford are reviewed. Past sorption studies evolved with time from generic, to waste-specific, to empirical waste-specific/site-specific studies. Current sorption studies are site-specific studies based on a radionuclide transport soil properties model (PERCOL). The radionuclide transport model PERCOL is briefly discussed. Radionuclide sorption is treated in the model by the use of laboratory developed empirical/statistical equations that predict sorption as a function of groundwater chemistry. Average sorption equations measured for 21 identified Hanford Separation Areas sediment types are presented and discussed. Statistical analysis of ^{90}Sr, ^{137}Cs, and ^{60}Co sorption for the 21 sediment types (63 equations) is given.

28311 **(RHO-SA—213) Mitigation of plant intrusion and subsequent uptake of buried radioactive waste through the use of herbicides.** Cox, G.R. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). 1981. Contract AC06-77RL01030. 9p. (CONF-810722—2). NTIS, PC A02/MF A01. Order Number DE81026580.

From International symposium on migration in the terrestrial environment of long-lived radionuclides from the nuclear fuel cycle; Knoxville, TN, USA (27 Jul 1981).

The use of shallow land burial techniques for isolation of low level radioactive waste is a common practice at many nuclear facilities, including Hanford. This paper describes the use of selective and non-selective herbicides as effective methods of precluding plant root intrusion into the buried radioactive wastes. The following methods are discussed: 1) Surface application of selective herbicides to control undesirable types of vegetation, and 2) Surface application of non-selective herbicides to control all vegetation.

28312 **(SAND—80-2675C) Isotopic techniques in radioactive waste disposal site evaluation: a method for reducing uncertainties I. T, T/^{3}He, ^{4}He, ^{14}C, ^{36}Cl.** Muller, A.B. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 10p. (CONF-810372—9). NTIS, PC A02/MF A01. Order Number DE81027209.

From Symposium on uncertainties associated with the regulation of the geologic disposal of high-level radioactive waste; Gatlinburg, TN, USA (9 Mar 1981).

This paper introduces five of the isotopic techniques which can help reduce uncertainties associated with the assessment of radioactive waste disposal sites. The basic principles and practical considerations of these best known techniques have been presented, showing how much additional site specific information can be acquired at little cost or consequence to containment efficiency. These methods, and the more experimental methods appearing in the figure but not discussed here, should be considered in any detailed site characterization, data collection and analysis.

28313 **(SAND—81-0002C) DNET: a model for incorporating feedback effects in salt dissolution processes.** Cranwell, R.M.; Campbell, J.E. (Sandia National Labs., Albuquerque, NM (USA); INTERA Environmental Consultants, Lakewood, CO (USA)). 1981. Contract AC04-76DP00789. 9p. (CONF-810372—10). NTIS, PC A02/MF A01. Order Number DE81027211.

From Symposium on uncertainties associated with the regulation of the geologic disposal of high-level radioactive waste; Gatlinburg, TN, USA (9 Mar 1981).

For nuclear waste isolation in deep, geologic formations, transport in groundwater appears to be one of the more likely means for radioactive waste to migrate from the depository to the biosphere. With respect to a depository in bedded salt, transport in groundwater would, for most breachment scenarios, have to be preceded by dissolution of all or portions of the salt layers surrounding the depository. The Dynamic Network (DNET) model provides a capability for investigating the rate of salt dissolution associated with a variety of disruptive events and processes and also provides a capability for investigating the effects of feedback mechanisms such as thermal expansion, subsidence, fracture formation and salt creep.

28314 **(SAND—81-1167C) Excavation design in rock salt: Laboratory experiments, material modelling and validations.** Wawersik, W.R.; Herrmann, W.; Montgomery, S.T.; Lauson, H.S. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 24p. (CONF-810698—1). NTIS, PC A02/MF A01. Order Number DE81023164.

From International symposium on rock mechanics related to caverns and pressure shafts; Bundesrepublik, Deutschland, F.R. Germany (26 Jun 1981).

The design of a radioactive waste isolation facility and of oil storage caverns in rock salt deposits in the US is supported by thermo-structural design calculations using a variety of finite element codes. Prerequisites for the successful application of such calculations are described: (1) Laboratory measurements of the time-dependent behavior of rock salt; (2) data smoothing, statistical data analyses and constitutive modelling of rock salt creep; and (3) testing of design predictions against independent measurements which were made both in the laboratory and in situ. Time-dependent rock salt properties were measured in single and multistage triaxial creep experiments up to 21 MPa confining pressure, 41 MPa principal stress difference (deviator stress) and 200°C temperature. Measurements included continuous records of stress, shear strain and volumetric strain with a resolution of strain rates to 2×10^{-11} 1/s.

28315 **(SAND—81-1174C) Risk assessment methodology for operating a bedded salt repository for unreprocessed spent fuel.** Raabe, P.H.; Campana, R.J.; Jensen, D.D.; Pepping, R.E. (Sandia National Labs., Albuquerque, NM (USA); General Atomic Co., San Diego, CA (USA)). 1980. Contract AC04-76DP00789. 12p. (CONF-810905—3). NTIS, PC A02/MF A01. Order Number DE81025395.

From ANS/ENS topical meeting on probabilistic risk assessment; Post Chester, NY, USA (20 Sep 1981).

This paper summarizes a six-month (~ 1 man-year) study performed for Sandia National Laboratories (SNL) by General Atomic Company (CA). The purpose of the study was to assemble a methodology to be used in assessing the public health risks associated with the operating phase of a bedded salt repository for disposing of unreprocessed spent nuclear fuel. The basic methodology selected for this purpose was probabilistic risk assessment (PRA). The study focused on a determination of releases of radionuclides (RNs) from the repository to its environe (atmosphere, surface land and waters, subterranean strata, and ground water). The methodology was broad enough to include all anticipated operations, including retrieval. This paper briefly describes the reference repository used as the basis for assembling and exercising the methodology, the types of facility analyses needed for a public health risk assessment, the preliminary screening needed to focus attention in the important areas of analysis, the event and fault trees developed to structure the accident scenarios and to guide the numerical analyses, the frequency and RN release analyses developed from those trees, and the results and conclusions from the study.

28316 **(SAND—81-1204C) Summary of research and development activities related to the US/FRG cooperative program on nuclear waste management.** Hunter, T.O.; Christensen, C.L.; Matalucci, R.V.; Wawersik, W.R.; Molecke, M.A. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 53p. (CONF-8106115—1). NTIS, PC A04/MF A01. Order Number DE81023685.

From US/FRG bilateral meeting; Bonn, F.R. Germany (8 Jun 1981).

Sandia National Laboratories (SNL) has established a Research and Development Program to investigate nuclear waste repository development in rock salt. This program is primarily based on the technical aspects of the Waste Isolation Pilot Plant (WIPP) Project, which considers only wastes from the US defense program. Portions of the program, however, have sufficient generic application to be incorporated into the National Waste Terminal Storage (NWTS) system. The program includes the following areas: high-level waste interactions; thermal/structural ineractions; radionuclide migration; fluid migration; sealing; and test development and design. The program areas include both waste package and repository development. Each program area can consist of several phases. These include: modeling activities to establish predictive techniques for performance assessment, laboratory investigations to gather data and isolate mechanisms, field tests to investigate large-scale and synergistic effects under realistic environmental conditions and, finally, in-situ tests conducted in the WIPP under actual repository conditions. This paper contains information summarized from documents, experimental data, and discussions provided by those individuals within the Sandia experimental program on the following four tasks: brine migration investigations; waste package materials program; benchmark calculations for thermomechanical codes; and rock mechanics constitutive model development.

28317 **(SAND—81-1718C) Uncertainty analysis for geologic disposal of radioactive waste.** Cranwell, R.M.; Helton, J.C. (Sandia National Labs., Albuquerque, NM (USA); Arizona State Univ., Tempe (USA)). 1981. Contract AC04-76DP00789. 13p. (CONF-810372—3). NTIS, PC A02/MF A01. Order Number DE81027206.

From Symposium on uncertainties associated with the regulation of the geologic disposal of high-level radioactive waste; Gatlinburg, TN, USA (9 Mar 1981).

The incorporation and representation of uncertainty in the analysis of the consequences and risks associated with the geologic disposal of high-level radioactive waste are discussed. Such uncertainty has three primary components: process modeling uncertainty, model input data uncertainty, and scenario uncertainty. The following topics are considered in connection with the preceding components: propagation of uncertainty in the modeling of a disposal site, sampling of input data for models, and uncertainty associated with model output.

28318 **(UNI-SA—80) Radionuclide removal from reactor wastes by HGMF.** Emory, B.B. (UNC Nuclear Industries, Inc., Richland, WA (USA)). 1 Apr 1981. Contract AC06-76RL01857. 3p. (CONF-810598—1). NTIS, PC A02/MF A01. Order Number DE81025644.

From International magnetics conference; Grenoble, France (12 May 1981).

This paper describes experiments conducted to support the use of a high gradient magnetic filter (HGMF) to remove radioactive particulate matter generated by internal decontamination of water-cooled nuclear reactors. Decontamination schemes for reduction of radiation exposure at power reactors call for the introduction of chemical reagents into the primary circuit to loosen and flush the radioactive corrosion products from the internal surfaces. This produces large volumes of liquid radioactive wastes which must be treated to remove the soluble and particulate material so that the water can be disposed of. Mechanical filters produce a large volume of filter material versus the volume of particulates removed and are limited as to the smallest particulate size removed, with resultant recontamination of the cleaned surfaces. The majority of the material removed is in the particulate form and is magnetically susceptible, therefore the HGMF has provided to be ideally suited to this application. 3 figures, 1 table.

28319 **(USGS-OFR—81-489) Water-level data for wells in and near Burial Ground 3, Oak Ridge National Laboratory, Tennessee, 1975-1979.** Webster, D.A.; Beatty, J.S.; Benjamin, P.M.; Tranum, W.M. (Geological Survey, Knoxville, TN (USA)). 1981. 39p. NTIS, PC A03/MF A01. Order Number DE81027192.

This report presents data pertaining to wells in the general vicinity of Burial Ground 3 at Oak Ridge National Laboratory, Tennessee, for the period 1975 to 1979. It includes an inventory of wells, measurements of water levels, well hydrographs, and a map showing the location of the wells.

28320 **Thermal convection at low Rayleigh number from concentrated sources in porous media.** Hickox, C.E. (Sandia National Laboratories, Albuquerque, N.M. 87185). DE-AC04-76DP00789. *Journal of Heat Transfer ;* **103**: No. 2, 232-236(May 1981).

A simple mathematical theory is proposed for the analysis of natural convective motion, at low Rayleigh number, from a concentrated source of heat in a fluid-saturated porous medium. The theory consists of retaining only the leading terms of series expansions of the dependent variables in terms of the Rayleigh number, is thus linear, and is valid only in the limit of small Rayleigh number. Based on fundamental results for a variety of isolated sources, superposition is used to provide solutions for situations of practical interest. Special emphasis is given to the analysis of sub-seabed disposal of nuclear waste.

28321 **Argon gas permeability of New Mexico rock salt under hydrostatic compression.** Sutherland, H.J. (Sandia Labs., Albuquerque, NM); Cave, S.P. *International Journal of Rock Mechanics and Mining Sciences and Geomechanics Abstracts ;* **17**: No. 5, 281-288(Oct 1980).

Laboratory measurements of the argon gas permeability for rock salt specimens from the Waste Isolation Pilot Plant (WIPP) site in Southeast New Mexico (SENM) are obtained by using a transient, pressure step technique. Permeabilities of seven specimens are investigated as a function of hydrostatic compression and time. These data, when evaluated with the results of other authors, lead to the conclusions that if this formation is in a state of hydrostatic compression in its undisturbed state, then its in situ permeability is less than 5×10^{-20} m^2. And, if any connected porosity is introduced into formation, as with mining, the formation can heal itself if it returns to a hydrostatic pressure state.

28322 **Thermal expansion and inferred permeability of climax quartz monzonite to 300°C and 27.6 MPa.** Heard, H.C. (Univ. of California, Livermore). Contract W-7405-ENG-48. *International Journal of Rock Mechanics and Mining Sciences and Geomechanics Abstracts ;* **17**: No. 5, 289-296(Oct 1980).

The coefficient of linear thermal expansion (α) has been evaluated for Climax Stock quartz monzonite at effective pressures (P) of 0, 13.8 and 27.6 MPa (0 to 276 bars) and at temperature (T) from 19 to 300°C. The samples evaluated were deliberately chosen to include imperfections such as healed fractures and large phenocrysts characteristic of the Climax pluton near the site of a high-level waste repository demonstration test at the Nevada Test Site. Values for α are neither constant with nor a simple function of T or P. For the range of T investigated, α ranges from 10 to 15.10^{-6} °C^{-1} at 0 MPa, from 7 to 13.10^{-6} °C^{-1} at 13.8 MPa, and from 7 to 12.10^{-6} °C^{-1} at 27.6 MPa. These values of α are greater than those expected for a similar but crack-free rock. Observations on the heated rock indicate that the thermal expansion is accompanied by new microcrack formation. At the temperatures to be expected in the wall rock near a waste canister, this increase in crack porosity is inferred to increase local permeability by factors of 2 to 5.

28323 **Seepage control using SBR/asphalt hot sprayed, elastomeric membranes.** Chambers, C.C. (Technol Manage Inc, Grand Junction, Colo). pp 271-288 of International conference on uranium mine waste disposal, 1st, 1980. Brawner, C.O. (ed.). New York, NY; Soc. of Min. Eng. of the AIME (1980).

From 1. international conference on uranium mine waste disposal; New York, NY, USA (19 May 1980).

The class of membranes tested are SBR/asphalt blends containing up to 68 weight percent asphalt, the balance being elastomeric polymers, fillers and phase compatibility promoters. The properties that make it suitable include chemical resistance, bacterial resistance, UV light resistance, permeability, stress/strain characteristics and bonding data. The economics of the system are also discussed. 9 refs.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 28218, 28227, 28266, 28275, 28276, 28310, 28311, 28312, 28315, 28323, 29214, 29244, 29251

28324 **(RHO-SA—211) Invasion of radioactive waste burial sites by the Great Basin Pocket Mouse (Perognathus parvus).** Landeen, D.S.; Mitchell, R.M. (Hanford Engineering Development Lab., Richland, WA (USA)). 1981. Contract AC06-77RL01030. 13p. (CONF-810722—6; IAEA-SM—257/58P). NTIS, PC A02/MF A01. Order Number DE81027816.

From International symposium on migration in the terrestrial environment of long-lived radionuclides from the nuclear fuel cycle; Knoxville, TN, USA (27 Jul 1981).

The invasion of burial sites by animals is a common problem documented at several nuclear facilities including Idaho National Engineering Laboratories (INEL), Savannah River, Oak Ridge, and Los Alamos. In order to establish effective deterrents for control of this problem, baseline information has been collected about specific parameters related to the potential for transport of radionuclides by animals. This study identifies parameters associated with burrowing activities of the Great Basin Pocket Mouse (Perognathus parvus) at the Hanford Site in Eastern Washington. The objectives of the study were: 1) document and compare burrow depths and soil volumes on a control site and a decommissioned radioactive waste site and 2) develop a system to estimate the depth and soil volume of burrows without requiring excavation. Animals were found to burrow deeper in the backfilled burial site ($x = .77$ m) than they did in the control site ($x = .43$ m). Burrows were probably deeper in the disturbed waste site due to limited compaction; and as a result, pocket mice have to dig deeper to maintain the integrity of the burrow system. Significant positive correlations ($p<.01$) were calculated from both study sites between burrow depth and soil volume and between mound diameter and soil volume. Based on these correlations, it should be possible to estimate burrow depths and soil volumes without excavation. Confidence levels and standard deviations are provided with these estimates. This method will allow estimates to be made of how much soil has been brought to the surface by pocket mice over a given period of time and may be useful in determining which waste sites could experience potential problems related to radionuclide transport. Recommendations based on these data can be used in the design of future burial facilities to prevent or mitigate the impact of encroachment by burrowing animals.

0540 Health And Safety

REFER ALSO TO CITATION(S) 28207, 28221, 28264, 28299, 28302, 28315, 28317, 28722

28325 **(SAND—81-0003C) Method for estimating the dose and health effects from geologic waste disposal.** Runkle, G.E.; Cranwell, R.M.; Johnson, J.D. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 19p. (CONF-810372—6). NTIS, PC A02/MF A01. Order Number DE81027205.

From Symposium on uncertainties associated with the regulation of the geologic disposal of high-level radioactive waste; Gatlinburg, TN, USA (9 Mar 1981).

The development of a methodology for assessing the risk from geologic disposal of radioactive wastes includes a model for estimating the individual dose and the resulting health effects from potential radioactive releases from a depository. Possible pathways to the human include ingestion of contaminated food and drinking water, inhalation of suspended radionuclides and external exposure rates in two zones. The exposure rates for the two zones are subsequently converted to dose and estimates of adverse health effects are made by the Dosimetry and Health Effects Model. Since the releases represent chronic lifetime exposures, 70 year intake/70 year dose commitment factors were developed from the work of J.K. Soldat and are used to convert the becquerel values to a dose commitment for the various body organs. Individual risk estimators based on BEIR II and the NRC recommendations from BEIR III are used to estimate the health effects from these dose levels. The ingestion pathway dominates the risk of fatal cancers in the scenarios analyzed to date. The highest risk estimates in Zone 1 result from the scenarios with well discharge directly from the groundwater aquifer to the biosphere.

0550 Regulations

REFER ALSO TO CITATION(S) 28722, 29497

28326 **(AGNS—35900-CONF-128) Access control system operation.** Barnes, L.D. (Allied-General Nuclear Services, Barnwell, SC (USA)). Jun 1981. Contract AC09-78ET35900. 19p. (CONF-810706—25). NTIS, PC A02/MF A01. Order Number DE81027807.

From Institute of Nuclear Materials Management conference; San Francisco, CA, USA (13 Jul 1981).

An automated method for the control and monitoring of personnel movement throughout the site was developed under contract to the Department of Energy by Allied-General Nuclear Services (AGNS) at the Barnwell Nuclear Fuel Plant (BNFP). These automated features provide strict enforcement of personnel access policy without routine patrol officer involvement. Identification methods include identification by employee ID number, identification by voice verification and identification by physical security officer verification. The ability to grant each level of access authority is distributed over the organization to prevent any single individual at any level in the organization from being capable of issuing an authorization for entry into sensitive areas. Each access event is recorded. As access events occur, the inventory of both the entered and the exited control area is updated so that a current inventory is always available for display. The system has been operated since 1979 in a development mode and many revisions have been implemented in hardware and software as areas were added to the system. Recent changes have involved the installation of backup systems and other features required to achieve a high reliability. The access control system and recent operating experience are described.

28327 **(CONF-810706—22) Operating experience with a near-real-time inventory balance in a nuclear fuel cycle plant.** Armento, W.J.; Box, W.D.; Kitts, F.G.; Krichinsky, A.M.; Morrison, G.W.; Pike, D.H. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 11p. NTIS, PC A02/MF A01. Order Number DE81025656.

From Institute of Nuclear Materials Management conference; San Francisco, CA, USA (13 Jul 1981).

The principal objective of the ORNL Integrated Safeguards Program (ISP) is to provide enhanced material accountability, improved process control, and greater security for nuclear fuel cycle facilities. With the improved instrumentation and computer interfacing currently installed, the ORNL ^{233}U Pilot Plant has demonstrated capability of a near-real-time liquid-volume balance in both the solvent-extraction and ion-exchange systems. Future developments should include the near-real-time mass balancing of special nuclear materials as both a static, in-tank summation and a dynamic, in-line determination. In addition, the aspects of site security and physical protection can be incorporated into the computer monitoring.

28328 **(CONF-810706—24(Draft)) NUMATH: a nuclear-material-holdup estimator for unit operations and chemical processes.** Krichinsky, A.M. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 6p. NTIS, PC A02/MF A01. Order Number DE81025620.

From Institute of Nuclear Materials Management conference; San Francisco, CA, USA (13 Jul 1981).

A computer program, NUMATH (Nuclear Material Holdup Estimator), has been developed to permit inventory estimation in

vessels involved in unit operations and chemical processes. This program has been implemented in an operating nuclear fuel processing plant. NUMATH's purpose is to provide steady-state composition estimates for material residing in process vessels until representative samples can be obtained and chemical analyses can be performed. Since these compositions are used for inventory estimation, the results are determined for and cataloged in container-oriented files. The estimated compositions represent material collected in applicable vessels-including consideration for material previously acknowledged in these vessels. The program utilizes process measurements and simple material balance models to estimate material holdups and distribution within unit operations. During simulated run testing, NUMATH-estimated inventories typically produced material balances within 7% of the associated measured material balances for uranium and within 16% of the associated, measured material balance for thorium during steady-state process operation.

28329 **(DOE/SF/90264—T1) Plutonium fuel factory control system.** (General Electric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.). Mar 1976. Contract AC03-77SF90264. 72p. NTIS, PC A04/MF A01. Order Number DE81026296.

The GE Plutonium Laboratory includes facilities and equipment for development and demonstration of the plutonium fuel fabrication cycle (Plutonium nitrate/oxide receipt, conversion to plutonium oxide or mixed (plutonium-uranium) oxide, mixed oxide fuel rod fabrication, scrap recovery, and real-time nuclear material control. These GE facilities and personnel provide excellent capability and resources to develop, demonstrate and test the plutonium fuel fabrication cycle under NRC license conditions. This proposal describes a program for development and demonstration of a plutonium fuel factory control.

28330 **(IS-M—332) Feasibility evaluation of remote, on-line plasma atomic emission spectroscopy for the direct multielement and multi-isotopic analysis of dissolver-tank solutions.** Edelson, M.C.; Fassel, V.A. (Ames Lab., IA (USA)). 1981. Contract W-7405-ENG-82. 7p. (CONF-810502—11). NTIS, PC A02/MF A01. Order Number DE81025447.

From 3. symposium on safeguards and nuclear material management; Karlsruhe, F.R. Germany (6 May 1981).

A high resolution spectrometer has been used to resolve the isotopic structure of lines emitted by uranium that has been atomized and excited in inductively coupled plasmas. Multi-isotopic analyses of uranium are presented along with high resolution spectra of simulated dissolver solutions. The potential application of this analytical technique to nuclear safeguards will be discussed.

28331 **(LA-UR—81-1978) Radiation detectors as surveillance monitors.** Fehlau, P.E.; Dowdy, E.J. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 26p. (CONF-810706—9). NTIS, PC A03/MF A01. Order Number DE81025375.

From Institute of Nuclear Materials Management conference; San Francisco, CA, USA (13 Jul 1981).

The International Atomic Energy Agency (IAEA) proposes to use personnel dosimetry radiation detectors as surveillance monitors for safeguards purposes. It plans to place these YES/NO monitors at barrier penetration points declared closed under IAEA safeguards to detect the passage of plutonium-bearing nuclear material, usually spent fuel. For this application, commercially available dosimeters were surveyed as well as other radiation detectors that appeared suitable and likely to be marketed in the near future. No primary advantage was found in a particular detector type because in this application backgrounds vary during long counting intervals. Secondary considerations specify that the monitor be inexpensive and easy to tamper-proof, interrogate, and maintain. On this basis radiophotoluminescent, thermoluminescent, and electronic dosimeters were selected as possible routine monitors; the latter two may prove useful for data-base acquisition.

28332 **(LA-UR—81-2178) Determining rejection regions and power that optimize the inspector's chances of detecting diversion and/or falsification.** Goldman, A.S.; Whitty, W.J.; Hafer, J.F.; Markin, J.T.; Shipley, J.P. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 9p. (CONF-810706—28). NTIS, PC A02/MF A01. Order Number DE81028780.

From Institute of Nuclear Materials Management conference; San Francisco, CA, USA (13 Jul 1981).

Three specific models are investigated: (1) diversion and k distinct falsifications (k + 1 degrees of freedom); (2) diversion and the accumulation of all the falsifications (2 degrees of freedom); (3) diversion only (1 degree of freedom). A test statistic has been derived for models (1) and (2) by the likelihood ratio procedure under the hypothesis of zero falsification and zero diversion versus a one-sided alternative of positive diversion, positive falsification, or both. An analogous test has been developed for model (3) for diversion only. A detailed discussion of this development is given by Shipley. J.P. Shipley, Notes for the Seminar on Data Generation and Evaluation for Safeguards, Los Alamos National Laboratory Seminar, Los Alamos, New Mexico, July 7-9, 1980 (to be published). Utilizing his notation, the test variables called Inspector's Sufficient Statistics - ISS_0, ISS_1, and ISS_2 - are used for testing the above three models (1), (2), and (3) respectively. Note that ISS_2 corresponds to the well-known MUF-D statistic, which is currently in vogue. These two tests, for purposes of this discussion, are equivalent. The objectives of this paper are to review the ISS procedures, develop optimal critical regions for ISS tests, and compare detection probability (power) curves for models (1), (2), and (3). Optimal critical regions depend upon values obtained from one-sided chi-squared tests with more than one degree of freedom. Details of such a procedure are not to be found in the literature, and this strange neglect was one of the motivating factors in this study.

28333 **(SAND—81-0594C) Use of penetration monitoring in safeguards systems.** Kaiser, S.; Bleck, M.E. (Sandia Labs., Albuquerque, NM (USA); Commission of the European Communities, Luxembourg). 1981. Contract AC04-76DP00789. 14p. (CONF-810706—19). NTIS, PC A02/MF A01. Order Number DE81026954.

From Institute of Nuclear Materials Management conference; San Francisco, CA, USA (13 Jul 1981).

A method for the performance assessment of penetration monitoring systems has been developed within the Containment and Surveillance Subgroup of the International Working Group on Reprocessing Plant Safeguards. The paper examines the use of this method and concludes that the technique is extremely useful in containment and surveillance system design and could also be valuable in operational safeguards systems providing the information generated was used with the care appropriate to the inherent assumptions.

28334 **(SAND—81-1469C) Concepts on integration of physical protection and material accounting functions in a safeguards system.** Reynolds, D.A. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 5p. (CONF-810706—20). NTIS, PC A02/MF A01. Order Number DE81025999.

From Institute of Nuclear Materials Management conference; San Francisco, CA, USA (13 Jul 1981).

Concepts on integration of physical protection and material accounting systems to enhance overall safeguards capability are developed and presented. Integration is approached by coordinating all safeguards information through a safeguards coordination center. This center represents a higher level in a communication, data-processing, and decision-making structure which is needed for efficient real-time operation of the integrated system. The safeguards coordination center functions to assess alarm and warning data required to resolve threats in the safeguards system, coordinate information and interaction involving the material accounting, physical protection, and facility monitoring and control systems, and present a single unified interface for interaction with facility management, facility operations, safeguards system personnel, and response forces.

28335 (SAND—81-1498C) Decentralized nuclear materials management system at SNLA. James, R.M. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 5p. (CONF-8106113—1). NTIS, PC A02/MF A01. Order Number DE81023686.

From 22. AESOP meeting; Idaho Falls, ID, USA (15 Jun 1981).

This paper discusses the approach that Sandia took in deciding to implement a nuclear material control and accountability system on a stand-alone minicomputer despite the existence of a Univac 1108 and Univac 1100/82 centralized facility. The benefits which have been obtained by the decentralization and future applications are discussed.

28336 (SRIA—115P49-1) Statistical and inventory procedures applied to nuclear-materials management. Final report. Dresch, F.W.; Butterfield, P.H.; Kinderman, E.M. (Stanford Research Inst., Menlo Park, CA (USA)). Apr 1966. Contract AM03-76SF00115. 112p. NTIS, PC A06/MF A01. Order Number DE81026140.

This report recommends centralized data reporting and analysis applied to inventory management and materials control. Adoption of this report will require a two-stage development program. In the first or study phase, a computer system (software) organization will take the lead role but will work closely with the AEC organization affected. The study phase, lasting three to four months, will delineate clearly the specific approaches to be taken, potential difficulties and advantages, costs, and the preliminary systems concept and specifications for the basic information system and procedures needed for statistical control and inventory management. The AEC, after review of the study phase, would normally proceed with detailed development, programming, and implementation in which it would be assisted by outside organizations, but in which it must play the dominant role. The basic information system needed for monitoring and statistical control of nuclear materials probably could be operable within a year from the start of the study phase. Implementation of more complex and specialized statistical and inventory management techniques would extend over another four to eight months.

06 FUSION FUELS

0602 Processing

28337 (DOE/DP/40030—3, pp 1.1-1.83) **Target fabrication technology.** Henderson, T.M. 1980. NTIS, PC A11/MF A01.

In Inertial fusion research. Annual technical report, 1980.

The KMSF support included the development of well-characterized, repeatable gas density profiles critical to a series of gas-jet experiments. Among our other national activities were those which led to the synthesis of metal-organic compounds useful to the Livermore program. Procedures and techniques for fabricating and characterizing the targets are discussed. Among these development activities, target characterization, fuel shell technology and multishell fabrication were given top priority. Characterization studies resulted in the implementation of a 4π interferometric inspection system, closely modeled after the TOPO I system originated by Livermore.

28338 (DOE/DP/40083—9) Production and characterization of pure cryogenic inertial fusion targets. Boyd, B.A.; Kamerman, G.W. (McDonnell Douglas Corp., St. Louis, MO (USA)). 1981. Contract AC08-79DP40083. 6p. (CONF-810812—30). NTIS, PC A02/MF A01. Order Number DE81025920.

From IECEC conference; Atlanta, GA, USA (9 Aug 1981).

An experimental cryogenic inertial fusion target generator and two optical techniques for automated target inspection are described. The generator produces 100 μm diameter solid hydrogen spheres at a rate compatible with fueling requirements of conceptual inertial fusion power plants. A jet of liquified hydrogen is disrupted into droplets by an ultrasonically excited nozzle. The droplets solidify into microspheres while falling through a chamber maintained below the hydrogen triple point pressure. Stable operation of the generator has been demonstrated for up to three hours. The optical inspection techniques are computer aided photomicrography and coarse diffraction pattern analysis (CDPA). The photomicrography system uses a conventional microscope coupled to a computer by a solid-state camera and digital image memory. The computer enhances the stored image and performs feature extraction to determine pellet parameters. The CDPA technique uses Fourier transform optics and a special detector array to perform optical processing of a target image.

28339 (KMSF-U—1097) Tritium induced x-ray emission from glass shell inertial fusion targets. Alexander, S.M.; Simms, R.J.; Anderson, P.R. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1981. Contract AC08-78DP40030. 15p. (CONF-810647—7). NTIS, PC A02/MF A01. Order Number DE81025599.

From Conference on X- and gamma-ray sources and applications; Ann Arbor, MI, USA (10 Jun 1981).

Spherical glass shells filled with fuel mixtures of deuterium, tritium, and occasionally additional gases are required as targets for the inertial fusion program. Accurate knowledge of the amount of tritium and other gases contained in the shell is necessary. The x-ray spectrum resulting from the interaction of beta particles with the constituents of the glass shell and gas fill is analyzed. A method is presented to reduce the effort required to relate x-ray yield to tritium content.

28340 (UCID—19092) Minimizing resputtering of Pt-coated microspheres in a batch magnetron sputtering process. Plake, A.L. (Lawrence Livermore National Lab., CA (USA)). 10 Jul 1981. Contract W-7405-ENG-48. 12p. NTIS, PC A02/MF A01. Order Number DE81027451.

Preventing DT loss from glass microspheres being smoothly coated with PT is needed during fabrication of laser fusion targets. Evidence indicates that the increase of substrate temperature due to resputtering will cause DT loss. Resputtering will prevent a smooth and uniform coating on these glass microspheres (140 μm in diameter). This paper reviews the method that was developed to find a set of coating conditions to minimize the DT loss, and still be able to produce thick smooth Pt coated glass microspheres.

28341 (UCRL—84488(Rev.1)) Use of molecular beams to support microspheres during plasma coating. Crane, J.K.; Smith, R.D.; Johnson, W.L.; Jordan, C.W.; Letts, S.A.; Korbel, G.R.; Krenik, R.M. (Lawrence Livermore National Lab., CA (USA)). 26 Aug 1980. Contract W-7405-ENG-48. 20p. (CONF-801037—9(Rev.1)). NTIS, PC A02/MF A01. Order Number DE81025601.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

Spherical targets can be levitated on beams of Ar or other gas atoms. This is an especially useful technique for supporting microspheres during plasma coating and processing. Measurements of gas flow and pressure indicate that the levitation device operates in the regime of Knudsen's flow. This device is currently being used in the development of future generation laser targets.

28342 (UCRL—85281) Reflection/transmission phase shift interferometer and viewing optics. Monjes, J.A.; Weinstein, B.W.; Willenborg, D.L. (Lawrence Livermore National Lab., CA (USA)). 15 Jun 1981. Contract W-7405-ENG-48. 25p. (CONF-810613—9). NTIS, PC A02/MF A01. Order Number DE81027658.

From Conference on lasers and electro-optics; Washington, DC, USA (10 Jun 1981).

The interferometer and viewing optics that are the main optical components of an Automated Surface Mapping system (ASM) used to characterize the surface topography and the wall thickness uniformity of opaque and transparent spherical shells is described. To characterize surface finish or wall thickness of spherical shells with an accuracy of 10 nm and a resolution of 1 μm the differential phase shift between two beams of orthogonal polarizations is measured, before and after the probe beam has interacted with the test object.

0603 By-products

28343 **(BNL—29281) Fusion as a source of synthetic fuels.** Powell, J.R.; Fillo, J.A.; Steinberg, M. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 10p. (CONF-810808—2). NTIS, PC A02/MF A01.

From Energy in the man-built environment: the next decade specialty conference; Vail, CO, USA (3 Aug 1981).

In the near-term, coal derived synthetic fuels will be used; but in the long-term, resource depletion and environmental effects will mandate synthetic fuels from inexhaustible sources - fission, fusion, and solar. Of the three sources, fusion appears uniquely suited for the efficient production of hydrogen-based fuels, due to its ability to directly generate very high process temperatures (up to ~ 2000°C) for water splitting reactions. Fusion-based water splitting reactions include high temperature electrolysis (HTE) of steam, thermochemical cycles, hybrid electrochemical/thermochemical, and direct thermal decomposition. HTE appears to be the simplest and most efficient process with efficiencies of 50 to 70% (fusion to hydrogen chemical energy), depending on process conditions.

0607 Waste Management

REFER ALSO TO CITATION(S) 29671

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

28344 **(UCRL-Trans—11694) Procedure and installation for the preparation of water or hydrogen enriched with deuterium.** (Lawrence Livermore National Lab., CA (USA)). Apr 1981. Translation of . Netherlands Patent 7,004,830. 9p. NTIS, PC A02/MF A01. Order Number DE81027176.

A procedure is described for the preparation of deuterium-enriched water or hydrogen during the preparation of hydrogen from an output product or mixture and water by means of exchange of hydrogen isotopes. With the assistance of at least one intermediate carrier medium, the hydrogen freed in the preparation of hydrogen is reduced in deuterium and the water which is supplied for the preparation of hydrogen is enriched with deuterium, whereby the water and freed hydrogen are repeatedly brought into contact with an intermediate carrier medium or intermediate carrier media. Either one or two intermediate carrier media may be used; the media may be H_2S, alcohol, ammonia, or H_2.

0702 Radiation Sources

REFER ALSO TO CITATION(S) 29176

28345 **(GEPP-TIS—575) Detection of high-voltage breakdown paths in vacuum devices.** Mehroff, T.K. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 8 Jun 1981. Contract AC04-76DP00789. 20p. NTIS, PC A02/MF A01. Order Number DE81026678.

A method for using finely divided iron powders in the detection of arc track paths on vacuum tube high voltage insulators has been successfully developed. A model based on electrostatic attraction indicates that this adhesive force is sufficient to retain one-micron-diameter iron particles over a spacing of five monolayers for charges as small as a single electron deficiency or excess. It is highly probable that charged areas remain on the high voltage insulators of neutron tubes for a considerable length of time after aging and electrical testing of tubes that experienced insulator wall breakdown during electrical aging. The validity of target arc marks (dendritic etchings) as an indication of vacuum breakdowns have been verified for erbium targets via correlation studies with electrical test data.

28346 **Delayed-neutron fraction in a pulsed spallation neutron source.** Carpenter, J.M. (Argonne National Lab., IL (USA)). *Nuclear Instruments and Methods ;* **175**: No. 2/3, 287-292(15 Sep 1980).

The fraction of delayed neutrons β (with T_1sub(/)$_2$ approx. > 0.025 s) in slow-neutron beams from a ^{238}U pulsed spallation neutron source is 0.0053 for 300 MeV protons. This appears to be the first measurement of this quantity. The result indicates that, for most classes of measurements, the delayed-neutron background in time-of-flight instruments will be important and places constraints on the physics description of spallation targets. The measurement was performed at the prototype pulsed spallation neutron source, ZINP-P', at Argonne National Laboratory.

0703 Isotopic Power Supplies

REFER ALSO TO CITATION(S) 29161, 29162

28347 **(DOE/SF/01123—T30) Alternate HSA design requirements.** (AiResearch Mfg. Co., Phoenix, AZ (USA)). 8 Mar 1977. Contract AC03-76SF01123. 16p. NTIS, PC A02/MF A01.

The requirements definition and a small amount of conceptual layout work which was performed for ERDA to provide assistance to NASA in conjunction with a program to develop advanced heat source assembly designs for use in the Brayton Isotope Power Systems (BIPS) are summarized.

28348 **(DOE/SF/01123—T39) Proposal for an advanced heat source assembly for the Isotope Brayton Power System. Volume 1. Technical program and statement of work.** (Teledyne Isotopes, Timonium, MD (USA). Energy Systems Div.). 9 Dec 1974. Contract AC03-76SF01123. 106p. (IESD—5062-1). NTIS, PC A06/MF A01. Order Number DE81026399.

The technical program plan for evaluating the performance and safety of a radioisotope-fueled Brayton power system for space vehicles is presented with schedules for evaluating heat source design and safety, for specifying power system requirements, and for the development and operation of a ground demonstration system. (LCL)

28349 **(DOE/SF/01123—T40) Thermal-transient analysis of the Brayton Isotope Power System (BIPS) recuperator.** (AiResearch Mfg. Co., Phoenix, AZ (USA); AiResearch Mfg. Co., Torrance, CA (USA)). Oct 1977. Contract AC03-76SF01123. 57p. NTIS, PC A04/MF A01.

The purpose of this study was to: examine the proposed Brayton Isotope Power System (BIPS) startup model; select the most favorable condition with regard to a recuperator cyclic life; perform a detailed transient heat transfer analysis; and compute the resultant thermal stresses and low cycle fatigue life. In addition, a study was performed to compare the predicted metal temperature transients with experimental data. Proposed system startup modes were examined and the most favorable method was selected. Detailed transient temperature analyses were performed for the selected startup sequence and temperature maps were developed for the response of the heat exchanger elements, bars, plates, fins, and manifolds. This data was the basis for subsequent structural analysis. Recommendations for heat exchanger modifications to obtain a more uniform thermal response throughout the structure are proposed. These changes would result in reduced thermal stresses and should be considered for follow-on, advanced recuperator designs. Good agreement between experimental data and transient temperature predictions is shown; the analytical techniques are verified. The structural analysis identified certain critical areas within the core assembly where a high thermal stress is developed. Low cycle fatigue cracks could develop in some of the critical areas after accumulating less than 100 startup cycles (design life). These cracks, if they propagate through the structure, would result in an internal bypass leak that would degrade system performance; however, no external leakage with loss of working fluid would occur. It is concluded that the recuperator low cycle fatigue life is adequate for the BIPS applications. Additional analyses are proposed to more rigorously define the three-dimensional thermal stresses and the re-

sultant cyclic life. These results will increase the confidence level in the present recuperator structural design.

28350 (DOE/SF/01123—T41) Preliminary Hazard Analysis for the Isotope Brayton Flight System. (AiResearch Mfg. Co., Phoenix, AZ (USA)). 31 Oct 1975. Contract AC03-76SF01123. 25p. NTIS, PC A02/MF A01. Order Number DE81025730.

A tabulated summary is presented of the hazards and undesired events which may lead to system damage or failure or personnel injury or death in the ground handling, transport, launching, operation, re-entry, and impact of the Brayton Isotope Power System fuel source for spacecraft power supplies. (LCL)

28351 (DP—1588) Impact failure of MHW fuel sphere MHFT 65: report on interagency task force investigation and SRL evaluation of failure, November 1979-February 1980. Taylor, D.H. (Du Pont de Nemours (E.I.) and Co., Gibbstown, NJ (USA). Eastern Lab.). Jun 1981. Contract AC09-76SR00001. 57p. NTIS, PC A04/MF A01. Order Number DE81028938.

Following a safety verification impact test failure of a Multi-Hundred Watt (MHW) fuel sphere made at Savannah River Plant, from which 2.1 g of $^{238}PuO_2$ escaped containment, the Department of Energy organized a task force to investigate the cause of the test failure and to assess the failure probability of MHW fuel made at SRP. The task force described a two-part failure mechanism: embrittlement of the iridium containment shell by phosphorus which may have been picked up from the fuel; and large shear strains in the iridium caused by shearing or push-through of large chunks of fuel. Because the likelihood of push-through in this failure model depends on preexisting cracks in the fuel and their orientation to the impact face, the probability of further impact failures could not be easily assessed. From independent analysis of the available data at the Savannah River Laboratory, we concluded that the impact failure was caused by phosphorus embrittlement of the iridium, and breaching during impact of the graphite impact shell surrounding and cushioning the iridium-clad fuel. Excessive strain in the iridium is caused by extrusion of the iridium into the breach. This model predicts that impact failure is essentially independent of pre-existing cracks in the fuel and that SRP fuel, upon impact, should have no more failures than previously used fuel made at Mound Facility. Impact data to date indicate that SRP fuel clad in DOP-26 iridium cladding actually has fewer impact failures than earlier fuel clad in undoped iridium at MF.

08 HYDROGEN

0801 Production

REFER ALSO TO CITATION(S) 28343, 28434

28352 (LBL—12877) Hydrogen production from the photosynthetic bacterium, Rhodopseudomonas sphaeroides. Macler, B.A. (Lawrence Berkeley Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 147p. NTIS, PC A07/MF A01. Order Number DE81025831.

Thesis.

The photosynthetic bacterium, Rhodopseudomonas sphaeroides can produce H_2 gas under certain conditions when supplied with an appropriate reduced carbon source. It was determined that the enzyme nitrogenase is responsible for this activity. It was observed that maximum rates of H_2 biosynthesis were achieved when the organism was grown anaerobically in the light in a medium containing minimal amounts of reduced nitrogen. An atmosphere low in N_2 also increased H_2 yields. The organism can utilize lactate, malate, fructose or sucrose to produce H_2. Glucose and gluconate are not normally so utilized. The energy charge, as described by Atkinson, was about 0.5 regardless as to whether the organism was producing H_2. Total nicotinamide adenine dinucleotide levels were three-times that of nicotinamide adenine dinucleotide phosphate. The steady-state ratios of reduced to oxidized forms of both of these compounds was about 0.2. Ammonium ion completely inhibited H_2 production at 1 mM. O_2 inhibited H_2 production completely and irreversibly in vivo when present above 8% in the atmosphere. N_2 did not completely suppress H_2 production at any level. Carbon monoxide at 10% in the atmosphere did not affect metabolism or inhibit H_2 production. Monofluoroacetate inhibited H_2 production from 10 to 70% depending on the strain and the carbon compound used for substrate. For cells grown on malate, fructose, or glucose, storage material formed was almost entirely polyglucose. During H_2 production, amino acids were not produced, even when an amino group donor such as glutamate was present. Metabolic pathways in glucose utilization were strain dependent. CO_2 fixation in cultures producing H_2 photoheterotrophically is minimal and occurs primarily via phosphoenolpyruvate carboxylase.

28353 Catalysis of the hydrogen evolution reaction by colloidal Ag anchored in perfluorosulfonate resin. Lee, P.C.; Meisel, D. (Argonne National Lab., IL). Contract W-31-109-ENG-38. *Journal of Catalysis ;* **70**: No. 1, 160-167(Jul 1981).

Colloidal silver particles were produced and characterized in the perfluorosulfonate membrane, Nafion 120. The size of the particles thus produced exceeds the size of the water clusters in the membrane. The hydrogen evolution reaction in the Cr^{2+}/H^+ system could be catalyzed by these membrane-anchored catalysts. The rate of this reaction was found to be first order in $[Cr^{2+}]$ and the reaction was found to be mass transport limited. Analysis of the rate of this reaction indicates that only a small fraction of the particles' surface is accessible to the reactants.

28354 Hydrogen and methane production through microbial photosynthesis. Benemann, J. (Univ. of California, Berkeley). pp 285-297 of Living systems as energy converters. Buvet, R. (ed.). Amsterdam, Netherlands; Elsevier/North-Holland Biomedical Press (1977).

Some approaches to the production of hydrogen and methane using microbial photosynthesis are presented. These ideas are based on the results of basic research in biological energy conversions, particularly photosynthesis and on the development of large-scale engineered algal photosynthesis systems. Hydrogen production by photosynthesis is a more direct process than methane production which requires bacterial fermentations of the algae biomass.

0802 Storage

28355 (DOE/ET/26910—T1) Development of hydrogen storage materials for application to energy needs. Final report. Liu, J.; Magee, C.B. (Denver Univ., CO (USA). Dept. of Metallurgy and Materials Science). Oct 1979. Contract AS02-78ET26910. 158p. NTIS, PC A08/MF A01. Order Number DE81026225.

The following alloy systems were screened: Ti-, Y-, and Ca-base alloys; AB_2, Laves phase structure type intermetallic compounds; CrB (B/sub f/) structure type intermetallic compounds; borides; intermetallic compounds with AB_3 and AB_4 stoichiometries; and RE-Ni system alloys. Ti-base alloys seem to be the most promising candidates. These types of alloys do not need a high hydrogen pressure during absorption or for the thermal cycling process for alloy activation. They can readily absorb hydrogen up to 3.75 wt % at room temperature. However, the 25°C desorption isotherms show that most of the alloy-hydrogen systems in this family are quite stable. High-temperature-assisted desorptions show that about 2 wt % of the hydrogen absorbed at room temperature can be released at about 200°C. Compositional adjustments in an attempt to destabilize these families of alloys were made. The effects of alloy additions of Fe, Co, Ni, Cr, Pd, Al, or Si were investigated as to their influence on hydride behavior. While the other alloy systems studied were not as promising as the Ti-base alloys in terms of hydrogen occlusion capacities, their hydriding characteristics are interesting and lead to a better understanding of metal hydride formation in general. Theoretical studies on the relationships between intermetallic compound structure and hydride formation were made from the geometric point of view. Four intermetallic compound structures were studied in terms of the types, members, and sizes of interstitial holes; the clustering of these holes; and the relationships between these holes, or clusters of holes, to the formation of hydrides of these compounds.

0806 Industrial And Commercial Use

REFER ALSO TO CITATION(S) 28935, 28936

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 28354, 28938, 29121

28356 (DOE/CS/40329—T1) Conversion of atactic polypropylene waste to fuel oil. Final report. Bhatia, J. (Procedyne Corp., New Brunswick, NJ (USA)). Apr 1981. Contract AC01-77CS40329. 164p. NTIS, PC A08/MF A01.

A stable, convenient thermal pyrolysis process was demonstrated on a large scale pilot plant. The process successfully converted high viscosity copolymer atactic polypropylene to predominantly liquid fuels which could be burned in commercial burners. Energy yield of the process was very high - in excess of 93% including gas phase heating value. Design and operating data were obtained to permit design of a commercial size atactic conversion plant. Atactic polypropylene can be cracked at temperatures around 850°F and residence time of 5 minutes. The viscosity of the cracked product increases with decrease in time/temperature. A majority of the pyrolysis was carried out at a pressure of 50 psig. Thermal cracking of atactic polypropylene is seen to result in sigificant coke formation (0.4% to 0.8% on a weight of feed basis) although the coke levels were of an order of magnitude lower than those obtained during catalytic cracking. The discrepancy between batch and continuous test data can be atrributed to lowered heat transfer and diffusion rates. Oxidative pyrolysis is not seen as a viable commercial alternative due to a significant amount of water formation. However, introduction of controlled quantities of oxygen at lower temperatures to affect change in feedstock viscosity could be considered. It is essential to have a complete characterization of the polymer composition and structure in order to obtain useful and duplicable data because the pyrolysis products and probably the pyrolysis kinetics are affected by introduction of abnormalities into the polymer structure during polymerization. The polymer products from continuous testing contained an olefinic content of 80% or higher. This suggests that the pyrolysis products be investigated for use as olefinic raw materials. Catalytic cracking does not seem to result in any advantage over the Thermal Cracking process in terms of reaction rates or temperature of operation.

28357 (DOE/PC/30220—T2) Catalytic combustion of synthetic fuels. Annual report, August 1, 1980-July 31, 1981. Kennedy, L.A.; Ruckenstein, E. (State Univ. of New York, Buffalo (USA). School of Engineering and Applied Science). 1981. Contract FG22-80PC30220. 20p. NTIS, PC A02/MF A01. Order Number DE81027555.

During the period August 1, 1980 to July 31, 1981, the efforts on this project were directed towards three goals: (1) catalyst development; (2) preliminary measurements of fuel bound nitrogen conversion; and (3) design of a droplet injector and vaporization section for use with synthetic liquids. Chromium oxides, magnesium oxide, cobalt oxides, manganese oxides, and iron oxides were examind for possible use as stable catalysts. As a result of the experiments, Cr_2O_3:Co_3O_4 mixtures with concentrations greater than 3% were chosen for the catalyst in the Task II experiments. The reduction of nitrogen oxide emission from combustion sources is currently an area of major interest. The objective of the experiment was to study the oxidation of a nitrogen bound fuel over a binary transition metal oxide catalyst. Argon-oxygen is the oxidizing gas. Propane doped with nitrogen gas will also be tested in the catalytic combustor. (DMC)

28358 Structure sensitivity of n-heptane dehydrocyclization and hydrogenolysis catalyzed by platinum single crystals at atmospheric pressure. Gillespie, W.D.; Herz, R.K.; Petersen, E.E.; Somorjai, G.A. (Univ. of California, Berkeley). Contract W-7405-ENG-48. *Journal of Catalysis ;* **70**: No. 1, 147-159(Jul 1981).

The dehydrocyclization and hydrogenolysis of n-heptane catalyzed by platinum single-crystal surfaces have been investigated at temperatures from 533 to 603 K in the range of 1 atm total pressure. The flat (111), stepped (557), and kinked (10, 8, 7) and (25, 10, 7) surfaces used in this study were characterized under ultrahigh vacuum by low-energy electron diffraction and Auger electron spectroscopy before and after reaction experiments. The initial rate of dehydrocyclization to toluene on the four surfaces increased in the selectivity of toluene production versus hydrogenolysis increased by an order of magnitude in the order (111) ≃ (25, 10, 7) < (557) ≃ (10, 8, 7). Hydrogenolysis, however, increased in the order (557) < (10, 8, 7) < (25,10,7). As a result, the selectivity of toluene production versus hydrogenslysis increased by an order of magnitude in the orders (25, 10, 7) < (111) < (10, 8, 7) < (557). The sum of the rates of hydrogenolysis and toluene production remains relatively constant. The effect of preoxidation of the single-crystal catalysts was to increase the rate of hydrogenolysis and decrease the rate of dehydrocyclization. In general, the reaction rates decreased with increasing reaction time. This decrease was shown to be the result of the deposition of irreversibly adsorbed carbonaceous species.

28359 Methanation over transition metal catalysts. II. Carbon deactivation of Co/Al_2O_3 in sulfur-free studies. Agrawal, P.K.; Katzer, J.R.; Manogue, W.H. (Univ. of Delaware, Newark). Contract E(11-1)-2579. *Journal of Catalysis ;* **69**: No. 2, 312-326(Jun 1981).

Hydrogenation of CO catalyzed by Co/Al_2O_3 was studied in an all-quartz internal-recycle reactor between 200 and 400°C and from 0.1 to 20% CO in H_2 at atmospheric pressure. The surface and subsurface regions of the aged Co/Al_2O_3 catalysts were investigated using Auger electron spectroscopy (AES). Two pseudo steady states were observed. The upper pseudo steady state corresponds to a cobalt surface mainly containing active reaction intermediates; the lower pseudo steady state corresponds to deactivated cobalt which has large deposits of graphitic carbon on its surface, and for which the bulk CO is carburized to great depths as shown by AES. Methane is the primary reaction product; other hydrocarbons constitute less than 10% of the total products formed. The activation energy for methanation over Co/Al_2O_3 in the upper pseudo steady state is 28 +- 2 kcal/mole, whereas that in the lower pseudo steady state is 16 +- 2 kcal/mole. The change in the activation energy appears to be caused by changes in the electronic structure of CO due to bulk carburization.

28360 Methanation over transition metal catalysts. III. Co/Al_2O_3 in sulfur-poisoning studies. Agrawal, P.K.; Katzer, J.R.; Manogue, W.H. (Univ. of Delaware, Newark). *Journal of Catalysis ;* **69**: No. 2, 327-344(Jun 1981).

Poisoning of Co/Al_2O_3 by H_2S in CO hydrogenation was studied in an all-quartz recycle reactor; the studies were carried out at atmospheric pressure and at 390°C with feed gas containing 1 to 4% CO in H_2 and 13 to 100 ppB H_2S. Sulfur-poisoned catalysts were analyzed using Auger electron spectroscopy (AES). Addition of 13 ppB H_2S reduced the steady-state methanation activity of Co/Al_2O_3 by more than 10^3-fold at 390°C; 90 ppB H_2S reduced the activity 10^4-fold. AES studies showed that the loss in methanation activity resulted from two-dimensional surface sulfide formation; no sulfur was present in the subsurface regions. In the sulfur poisoning of Co/Al_2O_3, carbon plays only a secondary role. Poisoning by sulfur appears to be due primarily to geometric blockage of sites, with one sulfur atom adsorbed per two surface Co atoms. Electronic effects due to sulfur adsorption are also important as evidenced by a 12 kcal/mole reduction in the activation energy for methanation upon poisoning.

28361 Fischer-Tropsch synthesis on a precipitated iron catalyst. Madon, R.J.; Taylor, W.F. (Exxon Research and Engineering Co., Linden, NJ). Contract E(46-1)-8008. *Journal of Catalysis ;* **69**: No. 1, 32-43(May 1981).

The Fischer-Tropsch synthesis was carried out at various experimental conditions on an unpoisoned and sulfur-poisoned precipitated, alkali-promoted iron-copper catalyst. The sulfur, present in the fixed catalyst bed as a longitudinal concentration gradient, had little effect on conversion or product selectivity. However, for both poisoned and unpoisoned catalysts, there was a significant change

in the CO conversion to CO_2 on going from a reaction temperature of 240 to 250°C. This suggests that there is a rapid change of our catalyst surface after 240°C; the surface changes from one that is effective for CO_2 formation to one that is not as effective. Finally, analysis of the condensed products led us to suggest that there are at least two types of sites for hydrocarbon chain formation, each with a slightly different value of the chain growth probability. 5 figures, 5 tables.

28362 **Characterization of Ni/TiO_2 catalysts by TEM, x-ray diffraction, and chemisorption techniques.** Smith, J.S.; Thrower, P.A.; Vannice, M.A. (Pennsylvania State Univ., University Park). Contract EG-77-S-02-4463. *Journal of Catalysis ;* **68**: No. 2, 270-285(Apr 1981).

Nickel crystallite sizes calculated from H_2, CO, and O_2 chemisorption are compared to those determined from x-ray diffraction (XRD) and transmission electron microscopy (TEM). Good agreement is obtained among all techniques for typical Ni/SiO_2 and Ni/Al_2O_3 catalysts, whereas sizes calculated from H_2 and CO chemisorption are far too large for Ni/TiO_2 catalysts. In contrast oxygen chemisorption provides values in excellent agreement with those from XRD and TEM, and indicates that monolayer coverages of CO and H_2 are much lower on TiO_2-supported nickel. This agreement also implies that oxygen monolayer coverage on TiO_2-supported nickel does not exceed unity regardless of crystallite size, whereas coverages of two or higher are observed on SiO_2- and Al_2O_3-supported nickel, in agreement with previous studies. Isobars for Co and H_2 adsorption on Ni/TiO_2 clearly show that activated adsorption is not responsible for the low CO and H_2 uptakes at 300°K. Low-contrast nickel crystallites on titania are observed in the TEM micrographs, indicating that nickel may exist with a raft-like morphology on this support. These results provide evidence that strong metal-support interaction behavior exists in the Ni/TiO_2 system.

28363 **Rate of methane oxidation controlled by free radicals.** Creighton, J.R. (Lawrence Livermore Lab, Calif). *ACS (American Chemical Society) Symposium Series ;* No. 134, 357-363(1980). (CONF-790917—).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

The model of heat release during methane oxidation is based on extending N.N. Semenov's model of the induction period to cover the period of heat release. Semenov's model assumes that some initial dissociation of the fuel leads to an intermediate species. This species, or some of its products, reacts with the fuel to create more of the intermediate species, implying branching reactions. It is concluded that free radical concentrations control both the induction time and the rate of fuel consumption, and depend only on a few critical rate constants and the concentration of the fuel and the oxidizer. 9 refs.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 28378, 28393, 28823, 28824, 29121

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 28382

28364 (CONF-810498—(Vol.2), pp 1055-1080) **Physical properties and combustibility of mixture of oil and charcoal.** Lopez, B.A.D.; Murata, H.; Tsukamoto, Y.; Saitoh, H.; Itagaki, H.; Watanabe, M.; Ohno, M.; Asai, M. 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

The present study was carried out to obtain basic data on the physical properties and combustibility of MOC (Mixture of Oil and Charcoal). Based on the obtained results, we carried out studies on conversion to MOC of an existing fuel oil fired boiler at the COPENE plant, Brazil. R and D activities on fuel conversion have increasing need in view of the acute fuel oil conservation needs. The sedimentation of charcoal in MOC under the following conditions could not be observed for seven days static storage: charcoal particle size with 73% passing No. 200 mesh, charcoal concentration 30%, added water concentration 2%, additive concentration 0.3% and MOC temperature 55°C. The burning profile of the MOC was measured with a thermogravimetric and differential thermal analyser. The burning profile of MOC with 22% charcoal concentration was practically identical to that of fuel oil, and even by increasing the charcoal concentration of the mixture to 50%, the combustion completion temperature remained practically unchanged. The combustion test of MOC was carried out with horizontal water-cooled cylindrical furnace (inner diameter 1.5 m x length 4.5 m). The burner used in the test is a steam jet type developed for combustion of solid/liquid mixture fuels. No tip wear was observed after 60 hours of operation. The changeover from MOC to fuel oil and vice-versa was carried out continuously without extinguishing the flame of the burner.

13 HYDRO ENERGY

REFER ALSO TO CITATION(S) 28822

28365 **(CONF-8003145—(Exc.)) Small-hydroelectric workshop.** (Department of Energy, Seattle, WA (USA). Region X). Mar 1980. 168p. NTIS, PC A08/MF A01.

From Small hydroelectric workshops; Boise, ID, USA (18 Mar 1980).

This workshop on small-scale hydroelectric power development covered the following subjects: the role of the Department of Energy in small hydro development throughout the US and specifically the DOE loan program for this purpose; the role of the Corps of Engineers in small-scale hydro development in the Pacific Northwest; an inventory of existing non-power dams in Idaho, Wyoming, and Oregon with an indication of their developable potential; the economics of small-scale hydro development with listings of the applicable financial assistance programs of 7 federal agencies; site assessment; how to make loan applications for feasibility studies; and licensing requirements and procedures. (LCL)

1303 Plant Design And Operation

REFER ALSO TO CITATION(S) 28366, 28367

1305 Economics And Management

28366 **(ANL/EES-TM—143) Small power production case study: Montello hydroelectric plant, Montello, Wisconsin.** Foltman, A.J.; Hub, K.A. (Argonne National Lab., IL (USA)). Nov 1980. Contract W-31-109-ENG-38. 40p. NTIS, PC A03/MF A01. Order Number DE81027130.

A case study of a small-scale hydroelectric plant to identify implementation problems is presented. The Montello hydroelectric plant is described including the background and history of the plant, the physical characteristics, the financial history and costs, operation, regulatory agencies, and the problems encountered in its operation. The analyses of the energy and capacity (demand) credits for the Montello hydroelectric plant when it is added to the Wisconsin Power and Light Company generating system is described. The WP and L base case and the results of the analyses are discussed. (WHK)

28367 **(DOE/ID/49004—1) Feasibility report on the potential hydroelectric development at Combie Dam.** (Nevada Irrigation District, Grass Valley, CA (USA); Tudor Engineering Co., San Francisco, CA (USA)). Oct 1980. Contract FM07-80ID49004. 141p. NTIS, PC A07/MF A01. Order Number DE81026670.

The results of an investigation of the technical, environmental, economic and financial feasibility of installing a hydroelectric powerplant at the existing Combie Dam on the Bear River in Nevada and Placer Counties, California, are discussed. This dam is owned and operated by the Nevada Irrigation District (the District) to act as a diversion and provide some storage for District water supply. The power plant would utilize flows which presently pass over the dam's spillway. The project would involve expanding the existing four foot diameter outlet on the southern gravity portion of

the dam, installing a penstock (approximately 175 feet long, 102 inches in diameter) and constructing a 3500 kilowatts (kW) power plant on the south bank of the river below the dam. The capital cost of the project, including interest during construction, would total approximately $4,500,000 in July 1980 dollars. The unit capacity cost of the project at the 1980 price level would be $1,285 per kilowatt. The energy production unit cost would be 41.4 mills per kilowatt hour in 1980, and 56.3 mills per kilowatt hour in 1984. Environmental impacts of the Combie Power Project would be minimal. The primary conclusion from this study is that the Combie Power Project is economically, environmentally and institutionally viable, at the present time if an adequate power purchase agreement can be reached. Continued escalation of energy values will make this project even more attractive. (WHK)

1306 Environmental Aspects

REFER ALSO TO CITATION(S) 28367

14 SOLAR ENERGY

REFER ALSO TO CITATION(S) 28778

28368 **(SAND—81-0764) Development of solar energy in Peru.** Pierson, H.O.; Nahui, A. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1981. Contract AC04-76DP00789. 27p. NTIS, PC A03/MF A01. Order Number DE81026031.

Peru receives a high degree of solar radiation, except for part of its coastal area, and has almost an ideal climate for the development of solar energy. A concerted effort has been made in Peru under the direction of ITINTEC's Division of Energy to take advantage of these conditions. Work focuses on (1) the development of low-temperature applications, including the design of passive solar-heated buildings for the high Andes, (2) the design and evaluation of various types of solar water heaters and crop dryers for both household and industrial uses (based on flat-plate collectors), and (3) the construction of a desalinization prototype plant. Photovoltaic systems are being investigated for suitable applications and have an excellent potential, especially in telecommunications.

28369 **(SERI/SP—763-700) Guide to exporting for US solar companies.** Thompson, P. (Solar Energy Research Inst., Golden, CO (USA)). Jun 1981. Contract AC02-77CH00178. 143p. NTIS, PC A07/MF A01. Order Number DE81026615.

Reasons for US solar manufacturers to export are discussed; and, after a descision has been made to export solar equipment and technology, how to export and where to export are primary goals. The manual presents some basic information to answer the how and where. It provides information concerning the services which are currently available to facilitate entry into foreign markets and the basic social, economic, and solar insolation data on over 70 foreign markets are presented. Statistical profile information for the 70 countries include population; per capita income; primary languages, literacy rate; ratio of urban and rural areas; monetary unit; population density; GNP; energy production; energy consumption; energy reserves; trade with US. (MCW)

1401 Resources And Availability

REFER ALSO TO CITATION(S) 29351

1404 Environmental, Legal, And Institutional Aspects

REFER ALSO TO CITATION(S) 28371, 28458, 28762, 28789, 28824

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 28352, 28364, 28938

28370 **(BNL—29668) Impurity effects in a-Si:H solar cells.** Delahoy, A.E.; Griffith, R.W. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 10p. (CONF-810526—38). NTIS, PC A02/MF A01. Order Number DE81025069.

From 15. IEEE PV specialists conference; Orlando, FL, USA (11 May 1981).

Solar cells fabricated using plasma-deposited a-Si:H alloys can be seriously degraded by the incorporation of certain impurities during deposition of the a-Si:H materials. Nominally intrinsic layers are adversely affected by the addition to the plasma of air, N_2 + O_2 mixtures (although by neither N_2 nor O_2 separately), PH_3 or SiH_3Cl (monochlorosilane). For example, the conversion efficiency of Pd/p-i-n solar cells is lowered from 3.1 to 1.5% by the presence in the plasma of 3000 ppM air during deposition of the i-layer. In this case, modification of the a-Si:H gap state density owing to synergistic effects of oxygen and nitrogen in the plasma leads to a collapse of the space charge region and the reduction of the μ tau product for holes. The deleterious effects on device performance of phosphine and monochlorosilane are also discussed.

28371 **(BNL—51284) Photovoltaic energy technologies: health and environmental effects document.** Moskowitz, P.D.; Hamilton, L.D.; Morris, S.C.; Novak, K.M.; Rowe, M.D. (Brookhaven National Lab., Upton, NY (USA). National Center for Analysis of Energy Systems). Sep 1980. Contract AC02-76CH00016. 121p. NTIS, PC A06/MF A01. Order Number DE81027693.

A documented quantitative analysis is presented of knowledge and uncertainty of the potential health and environmental consequences of producing electricity by photovoltaic energy systems. Potential health and environmental risks are identified by systematic examination of all steps in representative fuel and material supply cycles including extraction, processing, refining, fabrication, installation, operation, and disposal for four photovoltaic energy systems (silicon N/P single crystal, silicon metal/insulator/semiconductor (MIS) cell, cadmium sulfide/copper sulfide backwall cell, and gallium arsenide heterojunction cell) delivering equal amounts of useful energy (10^{12} Btu). For each step in the fuel and material supply cycles, materials demands, by-products, public health, occupational health, and environmental hazards are identified and assessed.

28372 **(DOE/CE—0012) Photovoltaic energy systems: program summary.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC). Jan 1981. 473p. NTIS, PC A20/MF A01. Order Number DE81026471.

The ongoing research, development, and demonstration efforts of the Photovoltaics Program are highlighted and each of the US Department of Energy's current photovoltaics projects initiated or renewed during fiscal year 1980 is described. The program is briefly summarized, including the history and organization and highlights of advanced research and development, testing, and utilization in federal facilities. An exhaustive bibliography is included. (LEW)

28373 **(DOE/ET/20407—T3) Heterostructure single-crystal-silicon photovoltaic cell. Type A, semiconductor heterojunction silicon devices. Quarterly report No. 1, September 27-December 31, 1976.** Ghosh, A.K.; Shaw, R.F.; Feng, T.; Fishman, C.; Merrin, S.; Grater, I. (Exxon Research and Engineering Co., Linden, NJ (USA). Government Research Labs.; Emdex Corp., Milford, CT (USA)). 8 Jan 1977. Contract AC03-76ET20407. 38p. NTIS, PC A03/MF A01. Order Number DE81026077.

In the Emdex/Innotech cells, a major portion of current losses are due to reflection and shadowing effects due to grids. The SnO_2 thin films act as an antireflection coating but is not comparable in performance to those used in commercial p/n junction solar cells. The shape of the spectral response curve was theoretically calculated by taking into account the reflection losses. In most

cases it is not necessary to assume an inversion layer at the surface to account for the decrease in spectral response at short wavelengths. Further, for these cells photocurrent suppression was not observed as suggested in some earlier published work by others. The diode factor, the reverse saturation current, series and shunt resistances were determined for these cells. The diode factor n determined from dark and light I-V are not the same as one would expect from a normal solar cell. The first batch of newly fabricated SnO_2/Si cells show low efficiency. The problems with these cells and ways to improve their performance are discussed.

28374 **(DOE/ET/20412—T1) Cadmium sulfide/copper ternary heterojunction cell research. Quarterly technical progress report, October 1, 1977-December 31, 1977.** Mickelsen, R.; Selikson, B.; Chen, W. (Boeing Aerospace Co., Seattle, WA (USA)). Jan 1978. Contract AC03-77ET20412. 23p. NTIS, PC A02/MF A01. Order Number DE81027705.

$CuInSe_2$ film preparation and characterization and $CuInSe_2$/CdS conceptual model development are reported. Theoretical analysis has shown the dependence of $CuInSe_2$ film stoichiometry on the separation between the elemental source positions. Chemical analysis by scanning electron microprobe quantometer has revealed the stoichiometry variation to be less than a few percent across the 2 inch by 2 inch film. To reduce the stoichiometric variation across the film width, the film deposition system was modified to include a high temperature vapor homogenizer chamber. The three major carrier transport mechanisms across the junction governing the I/V characteristics of the $CuInSe_2$/CdS cell are: (1) the Shockley diffusion mechanism, (2) recombination in the space charge region, and (3) recombination through interface states. Mechanism 1 is not expected in thin film heterojunctions. The diode I/V characteristics for interface state recombination has a diode ideality factor A equal to one, whereas $CuInSe_2$/CdS cells reported to date have a diode A factor of two, indicating space charge recombination. Changing the doping concentration of the $CuInSe_2$ would be a way of controlling recombination level involvement. This would lead to ideal A values and hence improved open circuit voltages.

28375 **(DOE/ET/23133—T1) Harvesting of close-spaced short-rotation woody biomass.** Cullen, D.E.; Barr, W.J. (Mathtech, Inc., Princeton, NJ (USA)). 15 Jun 1980. Contract AC01-78ET23133. 102p. NTIS, PC A06/MF A01. Order Number DE81025861.

Efforts to date were concerned with identifying the characteristics of prospective woody biomass farms; the requirements for harvested wood to provide feedstock for various conversion processes; the characteristics of harvesting, collecting, transporting, and storing equipment as used by the forest products and agriculture industries; the applicability of the foregoing equipment to close spaced, short-rotation biomass farms; and the modelling of alternative systems linking biomass farms and biomass conversion plants. (MHR)

28376 **(DOE/ET/23197—T2) Semicrystalline casting process development and verification. Quarterly progress report Number 2, September 19, 1980-December 19, 1980.** (Semix, Inc., Gaithersburg, MD (USA)). 1980. Contract FC01-80ET23197. 55p. NTIS, PC A04/MF A01. Order Number DE81025765.

The design and construction of the Prototype 2 Ubiquitous Crystallization Process system is reported. The system shows significantly higher thermal efficiency and more reliable temperature monitoring and control than that of earlier version. A sizing saw was constructed to accomodate 17.5 kg silicon bricks, and an internal diameter saw was used to wafer the bricks. Investigations into the structural, mechanical, and electrical characteristics of semicrystalline sheet material is reported. Also, comparative analysis of the semicrystalline material based on its performance in completed solar devices has begun. Quality control and measurement are briefly discussed. (LEW)

28377 **(DOE/ET/23408—1) Low-cost thin-film polycrystalline silicon solar cells. Quarterly project report No. 1, March 15, 1979-June 30, 1979.** Crownover, J.D.; van der Leeden, G.A. (Poly Solar, Inc., Garland, TX (USA)). Jul 1979. Contract AC03-79ET23048. 25p. NTIS, PC A02/MF A01. Order Number DE81016920.

The objective of this contract is to advance the thin film silicon solar cell technology developed at Southern Methodist University, Dallas, Texas, with a view toward achieving photovoltaic conversion efficiencies greater than 10% at a cost of $100 to $300/kWe. The technology developed at SMU consists of: (1) the purification of metallurgical silicon by acid extraction and phosphorus pentoxide treatment, (2) the preparation of metallurgical silicon substrates by the unidirectional solidification of the melt on graphite, (3) the deposition of a silicon p-n junction structure on metallurgical silicon substrates by the thermal reduction of trichlorosilane, and (4) the application of grid contacts and anti-reflection coatings. Major efforts during this period have been directed to the organization and planning of the overall technical approaches, particularly in regard to the preparation of metallurgical silicon substrates. The zone-melting technique has been selected for the preparation of substrates, and a moving-coil zone-melting apparatus has been designed and constructed. A chemical vapor deposition apparatus for the deposition of the active region of solar cell has also been designed and constructed. In addition, the purification of metalurgical silicon by acid-extraction has been investigated semi-quantitatively.

28378 **(DOE/ID/12098—T2) Solar Ethanol Demonstration Plant: report of Phase I, technology assessment and Phase II, concept selection.** (American Agriculture Foundation, Inc., Denver, CO). 1 Jan 1981. Contract AC07-80ID12098. 82p. NTIS, PC A05/MF A01. Order Number DE81027183.

The solar ethanol demonstration plant is a most versatile facility for demonstrating the feasibility of on-farm, small scale ethanol production using solar energy as the primary heat source. This facility will be capable of processing the full range of feed stocks - not only the sugar and starch crops but also the cellulose feedstocks on which little data have been collected. This plant is unique in that it will be designed to permit the addition of modules (needed for the processing of cellulose and/or the demonstration of the continuous cycle) and the interchange of components such as fermenters, distillation columns, and molecular sieves which will enable comparative performance data among specific components. The feasibility of solar energy in ethanol production and the utilization of cascaded waste heat for other on-farm uses are also major design features. Engineering and cost analysis was performed to formulate a preliminary design for a unique solar ethanol demonstration plant for on-farm use. Energy requirements were calculated for a variety of starches, simple sugars, and cellulose. These requirements, in increasing order of Btu's required per gallon of ethanol produced, were simple sugars (low), grains (moderate), and cellulose (high). A complete listing of all feedstocks examined is presented. Chapter II provides the design requirements and the detailed process plant design information with flow, layout and performance information. Chapter III provides the results of the ethanol feedstock energy requirements study and chapter IV contains supporting details of the solar collector selection process. The three appendixes which follow address the ethanol fermentation process, the range of cellulose-ethanol production processes, and a detailed description of the Solar Collector performance model.

28379 **(DOE/JPL—1012-53) Low-cost solar-array structure development. JPL Publication 81-30.** Wilson, A.H. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Jun 1981. Contract AI01-76ET20356. 48p. NTIS, PC A03/MF A01. Order Number DE81028677.

Early studies of flat-plate arrays have projected costs on the order of $50/m^2$ for installed array support structures. An optimized low-cost frame-truss structure is described that is estimated to cost below $25/m^2$, including all markups, shipping, and installation. The structure utilizes a planar frame made of members formed from light-gauge galvanized steel sheet and is supported in the field by treated-wood trusses that are partially buried in trenches. The buried trusses use the overburden soil to carry uplift wind loads and thus to obviate reinforced-concrete foundations. Details of the concept, including design rationale, fabrication and assembly experience, structural testing, and fabrication drawings are included.

28380 (DOE/JPL/955382—79/8) Investigation of the hydrogenation of $SiCl_4$. Final report, March 31, 1979-April 1, 1981. Mui, J.Y.P.; Seyferth, D. (Massachusetts Inst. of Tech., Cambridge (USA)). 15 Apr 1981. Contract NAS-7-100-955382. 122p. NTIS, PC A06/MF A01. Order Number DE81025543.

A two-year research and development program was initiated in April of 1979 to study the hydrochlorination of silicon tetrachloride and metallurgical grade (m.g.) silicon metal to trichlorosilane, $3\ SiCl_4 + 2H_2 + Si \rightleftharpoons 4\ SiHCl_3$. A laboratory scale pressure reactor was constructed to study this reaction at pressures up to 500 psig. Reaction kinetic measurements were carried out as a function of reactor pressure, reaction temperature and $H_2/SiCl_4$ feed ratio. Based on the reaction kinetic data, the hydrochlorination of $SiCl_4$ and m.g. silicon metal is found to be an efficient process to produce $SiHCl_3$ in good conversions and in high yields. Copper is an effective catalyst. Results of a corrosion study show that conventional nickel-chromium alloys are suitable material of construction for the hydrochlorination reactor. The hydrochlorination reaction is relatively insensitive to external process parameters such as silicon particle size distribution and the impurities in the m.g. silicon metal.

28381 (DOE/JPL/955787—81/1) Cost-effective flat-plate photovoltaic modules using light trapping. Final report. Bain, C.N.; Gordon, B.A.; Knasel, T.M.; Malinowski, R.L. (Science Applications, Inc., McLean, VA (USA)). Apr 1981. Contract NAS-7-100-955787. 239p. NTIS, PC A11/MF A01. Order Number DE81018056.

Work in optical trapping in thick films is extended to form a design guide for photovoltaic engineers. Details of the methods, techniques, and considerations that are used in the definition and analysis of light trapping photovoltaic panels are provided. Assumptions, sources of data, optical and cost modeling methods and the techniques used in the analysis are included. The ways to use light trapping are discussed, and methods are described to use simplified design and costing equations to predict performance and cost benefits. Four significant ways to use the findings presented are: a minimum design change module; an optimum packing factor module concept; roof or wall integrated panels; and modules using light trapping from cell grids. Finally, a design guide is included which shows how to construct photovoltaic modules to exploit light trapping. It is claimed that up to 20% improvements in standard module performance can be expected. (LEW)

28382 (DOE/SF/90481—T1) Secondary alternate fuels (SAF) preliminary program plan (emphasizing fuelwood utilization): a preliminary report of combustion technology R and D status. (TRW, Inc., McLean, VA (USA). Energy Systems Planning Div.). 30 Jun 1977. Contract AT03-76SF90481. 28p. NTIS, PC A03/MF A01.

A preliminary program plan to mature the technology for commercialization of selected combustion systems using biomass residues and industrial wastes is presented. The projects are divided as follows: the fuelwood supply project and the secondary alternate fuels industrial applications project. The latter project includes direct combustion and pyrolytic two-phase fuel turbine combustion. (MHR)

28383 (DOE/TIC—1027418) Computer modelling of amorphous materials for photovoltaic conversion. Fourth quarterly progress report. (Argonne National Lab., IL (USA)). 22 Oct 1979. Contract W-31-109-ENG-38. 4p. NTIS, PC A02/MF A01. Order Number DE81027418.

Previous reported work on pure, defect-free amorphous silicon, a-Si with dangling bonds, and hydrogenated amorphous silicon is summarized. The formal charge of an atom involves terms referring to the atom itself, the 4 first neighbors, the 12 second neighbors, and the rest of the N atoms in the unit. Separate computations of the contributions from each of the first three groups listed reveal that the contribution from the fourth group of atoms is negligible to an excellent approximation, thus simplifying the analysis of the charge distribution. Models are being constructed containing about 10 at. % H, and their neutron diffraction patterns are being calculated. (LEW)

28384 (DOE/TIC—1027419) Computer modelling of amorphous materials for photovoltaic conversion. Third quarterly progress report. (Argonne National Lab., IL (USA)). 25 Jul 1979. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01. Order Number DE81027419.

An attempt is made to correlate the charge with structural parameters of amorphous silicon without defects, and so to extract a simple physical picture of how the structural disorder affects the electronic states. The results of a least-squares fit are shown for five examples of periodic models, each with 54 atoms in the repeating unit. For a-Si with dangling bonds, it is found that the defect band lies much closer to the conduction band than to the valence band. Computations on several examples of a model in which a hydrogen atom is attached to each of two silicon atoms at some distance from each other in a 54 atom random network which is otherwise perfect shows a localized bonding state for each H atom at the bottom of the valence band. (LEW)

28385 (DOE/TIC—1027420) Computer modelling of amorphous materials for photovoltaic conversion. Second quarterly progress report. (Argonne National Lab., IL (USA)). 16 Apr 1979. Contract W-31-109-ENG-38. 11p. NTIS, PC A02/MF A01. Order Number DE81027420.

The results of exploration of various aspects of electron localization in models of amorphous silicon are reported. The Mulliken localization parameter and the charge-charge distribution function for defect-free a-Si are examined. Dangling bond defects and amorphous silicon-hydrogen alloys are also studied. (LEW)

28386 (DOE/TIC—1027421) Computer modelling of amorphous materials for photovoltaic conversion. Eleventh quarterly report. Guttman, L. (Argonne National Lab., IL (USA)). 16 Jul 1981. Contract W-31-109-ENG-38. 14p. NTIS, PC A02/MF A01. Order Number DE81027421.

The construction of computer models of a-(Si,H) containing dihydride units is reported and described. The computed elecronic structure, including the total density of states and the density around hydrogen is reported. (LEW)

28387 (DOE/TIC—1027469) Computer modelling of amorphous materials for photovoltaic conversion. Fifth quarterly progress report. (Argonne National Lab., IL (USA)). 29 Jan 1980. Contract W-31-109-ENG-38. 3p. NTIS, PC A02/MF A01. Order Number DE81027469.

Methods are suggested for experimentally determining the charge distribution of pure amorphous silicon: one using neutron inelastic scattering and infrared absorption, and the other using nuclear magnetic resonance. A program of computations using a self-consistent pseudo-potential method is reported begun. An alternative scheme for modeling dangling-bond defects is reported which involves removal of two atoms from a model network, rearranging to leave only two dangling bonds, and saturating them with H atoms. (LEW)

28388 (DOE/TIC—1027515) Computer modelling of amorphous materials for photovoltaic conversion. Ninth quarterly report. Guttman, L. (Argonne National Lab., IL (USA)). 21 Jan 1981. Contract W-31-109-ENG-38. 11p. NTIS, PC A02/MF A01. Order Number DE81027515.

Pseudopotential computations are described which are used to examine the localization parameter of pure a-Si. Electronic structure calculations for a-(Si,H) are also discussed. Three methods of identifying the states associated with hydrogen are described. It is found that the addition of 10% or so of H to a-Si does not drastically alter the density of states. The states associated with H are not well-defined in energy, but are uniformly distributed throughout the region associated with Si. Two states were found near the gap for the six-hydrogen model, one just above and one just below the Fermi level. (LEW)

28389 (DOE/TIC—1027545) Computer modelling of amorphous materials for photovoltaic conversion. Eighth quarterly and second annual report. Guttman, L. (Argonne National Lab., IL (USA)). 30 Sep 1980. Contract W-31-109-ENG-38. 9p. NTIS, PC A02/MF A01. Order Number DE81027545.

Work previously reported on the electronic structure of pure and hydrogenated amorphous silicon and the construction of models is summarized. Little progress is reported in the analytical theory, and efforts to gain some insight into the factors which affect the electronic structure are described. Efforts are reported to include hydrogen atoms in the model from the start rather than first removing silicon atoms. (LEW)

28390 **(DOE/TIC—1027546) Computer modelling of amorphous materials of photovoltaic conversion. Seventh quarterly progress report.** Guttman, L. (Argonne National Lab., IL (USA)). 30 Jun 1980. Contract W-31-109-ENG-38. 28p. NTIS, PC A03/MF A01. Order Number DE81027546.

A structural model of a-(Si:H) with H atoms covalently bound to Si atoms that are otherwise part of the normal random network is described. The calculated structural properties are compared with slow-neutron scattering data. The charge distribution of an example model of a-Si is analyzed using the self-consistent pseudopotential calculations. Another example model of amorphous silicon containing two H atoms has also been treated. (LEW)

28391 **(DOE/TIC—1027547) Computer modelling of amorphous materials for photovoltaic conversion. Sixth quarterly progress report.** (Argonne National Lab., IL (USA)). 30 Apr 1980. Contract W-31-109-ENG-38. 10p. NTIS, PC A02/MF A01. Order Number DE81027547.

The theory of the electronic structure of a-(Si, H) is briefly reviewed, and a comparison is made between neutron-diffraction experimental data and periodic random network models. A new method of computing the electronic structure of a-Si using linear combinations of free electron wave functions is compared with the Orthogonalized Linear Combinations of Atomic Orbitals method. (LEW)

28392 **(DOE/TIC—1027568) Computer modelling of amorphous materials for photovoltaic conversion. Tenth quarterly report.** Guttman, L. (Argonne National Lab., IL (USA)). 8 Apr 1981. Contract W-31-109-ENG-38. 9p. NTIS, PC A02/MF A01. Order Number DE81027568.

The electronic structure of a-(Si,H) has been examined by improved analysis that revealed features of the data previously obscured by statistical fluctuation. The hydrogen-associated states, particularly those near the Fermi energy, are discussed. (LEW)

28393 **(LBL—12603) Process development studies of the bioconversion of cellulose and production of ethanol. Semi annual report.** Wilke, C.R.; Blanch, H.W. (Lawrence Berkeley Lab., CA (USA)). Apr 1981. Contract W-7405-ENG-48. 104p. NTIS, PC A06/MF A01. Order Number DE81028541.

Progress in the following process development studio is reported: economic evaluation of hydrolysis and ethanol fermentation schemes, economic evaluation of alternative fermentation processes, raw materials evaluation, and evaluation of pretreatment process. Microbiological and enzymatic studies reported are: production of cellulase enzyme from high yielding mutants, hydrolysis reactor development, xylose fermentation, and xylanese production. Fermentation and separation processes include: process development studies on vacuum fermentation and distillation, evaluation of low energy separations processes, large scale hollow fiber reactor development. (MHR)

28394 **(NYSERDA—80-31-Vol.1) Development of forest biomass energy estimates for New York.** (State Univ. of New York, Albany (USA). Research Foundation; State Univ. of New York, Syracuse (USA). Coll. of Environmental Science and Forestry). Dec 1980. 151p. New York State Energy Research and Development Authority, Albany. Order Number DE81026347.

First estimates of forest biomass (potential energy feedstock) now standing and growing in New York are provided. Trees were felled, cut and weighed and the data used to develop weight prediction equations for commonly occurring species in New York. These equations were used to prepare tree weight tables (Volume II) and a forest biomass atlas for New York that shows the geographic distribution of forest biomass in the state. A tree biomass growth model was also developed for use in smaller, user-defined areas. A feasibility study for a silvicultural biomass farm (planting hybrid poplar) was prepared for a specific site in Seneca County so that its potential could be assessed. The information in this report will be of interest to users and potential users of forest biomass in New York.

28395 **(NYSERDA—80-31-Vol.2) Development of forest biomass energy estimates for New York.** (State Univ. of New York, Albany (USA). Research Foundation; State Univ. of New York, Syracuse (USA). Coll. of Environmental Science and Forestry). Dec 1980. 58p. New York State Energy Research and Development Authority, Albany. Order Number DE81026348.

Weight tables for whole trees (including the entire main stem, branches, and leaves or needles, but not including the stump and root system) were developed for 10 major species in New York. These were derived from prediction equations. The species are: sugar maple, red maple, hemlock, white pine, red oak, beech, white ash, spruce, aspen, and yellow birch. These weight tables may be used as a substitute, or in conjunction with, volume tables in forest inventory when weight is the measurement of interest. Volume I contains the background and basis of determination of the tables.

28396 **(SERI/PR—8062-1-T11) Zn_3P_2 as an improved semiconductor for photovoltaic solar cells. Eleventh quarterly report, March 1, 1981-May 31, 1981.** (Delaware Univ., Newark (USA). Inst. of Energy Conversion). 1981. Contract AC02-77CH00178. 35p. NTIS, PC A03/MF A01. Order Number DE81027505.

Mg/Zn_3P_2 devices were prepared on thin Zn_3P_2 films grown on mica/Fe/Si substrates. The highest total area conversion efficiency achieved on a 1 cm^2 area cell under smulated AM-1 illumination was 4.3%. The seris resistance in the cells was $\leqq 5\ \Omega\ cm^2$ and a fill factor as high as 57% was observed. The J/sub sc/ ($\sim$ 17 mA/cm^2) was compared to similar devices on large grain bulk Zn_3P_2 wafers. Spectral response and laser spot scans indicate a longer electron diffusion length in these films compared to films prepared on mica/Fe/C silicon steel substrates. The series resistance in the devices decreased at higher temperatures. It appears that the back contact resistance is a major contributing factor to the total series resistance of the device. The composition of this Zn_3P_2 films grown by close-spaced vapor transport on mica substrates was determined by x-ray fluorescence analysis. Electron beam induced current (EBIC) measurements were made on a Mg/Zn_3P_2 device and the surface recombination velocity was determined to be $\sim 10^2$ cm/sec. Attempts were made to measure the drift mobility in bulk and thin film Zn_3P_2. Experiments are being conducted to prepare high resistivity Zn_3P_2 to see the evidence of n type conductivity by annealing in Zn at temperatures up to 925°C. Seeded crystal growth, using a seed with (101) plane at an angle to the saw cut face resulted in a boule with 2-3 large grains. The performance of ZnO/Zn_3P_2 devices has been lower than expected. The V/sub oc/ in these devices is $<$ 0.4 Volts and the maximum active area conversion efficiency has been $\sim$ 2%.

28397 **(SERI/PR—9100-1-T1) Exploratory development of thin film polycrystallline silicon photovoltaic devices. Production of self-supporting microcrystalline silicon films. Topical report No. 1.** Sarma, K.R.; Rice, M.J.; McIntosh, G. (Motorola, Inc., Phoenix, AZ (USA)). Apr 1981. Contract AC02-77CH00178. 37p. NTIS, PC A03/MF A01. Order Number DE81026224.

Deposition of thin film polycrystalline silicon films on molybdenum substrates, and their separation, intact, during cooldown following the deposition process, have been repeatedly demonstrated. Deposition parameters using a high pressure plasma source have been studied for inputs of $SiCl_4$, $SiHCl_3$ and SiH_2Cl_2. Conditions for obtaining the best combination of deposition efficiency, throughput rate, and surface morphology are specified. These data were used to design a continuous system in which the Si films are deposited on all four walls of square boxes that are moved continuously down the high temperature chamber, thus permitting uniform film thickness and optimum throughput. The continuous apparatus incorporates series of sensors to permit safe and reproducible operation, and can be controlled entirely by a microprocessor system.

28398 **(SERI/PR—9195-1-T1) Improved amorphous Si solar cells. Quarterly progress report, August 1-October 31, 1980.** Dalal, V.L. (Delaware Univ., Newark (USA). Inst. of Energy Conversion). 1980. Contract AC02-77CH00178. 39p. NTIS, PC A03/MF A01.

A model for explaining the growth, H incorporation and bandgap data in a-Si deposited from (SiF_4 + H_2) has been developed. It is proposed that the a-Si films are subjected to reactive ion etching and ion bombardment during growth, which may lead to lower defect densities (and hence lower H content) and microcrystallinity in doped films. A morphological study of B-doped a-Si:H has also been carried out. It is found that there are certain regions of pressure, temperature and relative B_2H_6 concentrations which lead to agglomerative growth. Study of drift mobility of electrons has continued. We have obtained very high drift mobilities, (~ 0.8 cm^2/V-sec) on thick films (~ 3 μm). Thin films (~ 1 μm) have significantly lower mobilities. It is proposed that this phenomenon is due to the existence of a transition layer between the substrate and high quality a-Si. We have continued nip device fabrication in a-Si:H. The following parameters have been obtained individually on cells of 0.24 cm^2 area. J/sub sc/ (internal) = 12 mA/cm^2 @ 100 mW/cm^2, V/sub oc/ = 820 mV, and FF = 0.56 are obtained.

28399 **(SERI/TP—611-1226) Interface reactions in Mg/Zn_3P_2 solar cells.** Kazmerski, L.L.; Ireland, P.J.; Catalano, A. (Institute of Energy Conversion, Newark, DE (USA); Solar Energy Research Inst., Golden, CO (USA)). May 1981. Contract AC02-77CH00178. 5p. (CONF-810526—30). NTIS, PC A02/MF A01. Order Number DE81025773.

From 15. IEEE PV specialists conference; Orlando, FL, USA (11 May 1981).

The composition and chemistry of the Mg/Zn_3P_2 interface is studied using surface analysis techniques. For higher carrier concentrations ($p > 10^{17}/cm^3$), a heterojunction occurs by the chemical interaction of the Mg with Zn_3P_2 to form Mg_3P_2. For lower carrier concentrations ($p < 10^{17}/cm^3$) this reaction does not take place, and Mg diffuses into the Zn_3P_2. Diffusion coefficients of Mg in Zn_3P_2 are determined. Grain (crystalline) and grain boundary components of the diffusion coefficient are evaluated. These data compare very well with that reported using electron beam induced currents and spectral response measurements.

28400 **(SERI/TP—611-1231) Growth of silicon sheets from metallurgical-grade silicon.** Ciszek, T.F.; Schietzelt, M.; Kazmerski, L.L.; Hurd, J.L.; Fernelius, B. (Solar Energy Research Inst., Golden, CO (USA)). May 1981. Contract AC02-77CH00178. 9p. (CONF-810526—32). NTIS, PC A02/MF A01. Order Number DE81025703.

From 15. IEEE PV specialists conference; Orlando, FL, USA (11 May 1981).

Impure silicon is difficult to solidify in sheet form because of morphological protuberances which may result from constitutional supercooling. Sheet growth methods which require a specific crystallographic orientation or which are characterized by a narrow melt meniscus are most affected by this problem. The edge-supported pulling technique is applied to sheet growth of metallurgical grade silicon and DAR (Direct Arc Reactor) silicon. The 7mm meniscus height associated with this technique has allowed the growth of 5 cm wide sheets from both materials. In each case, the sheets were p-type. Metallurgical grade silicon resulted in .05 to .23 Ω-cm resistivities while DAR silicon produced .10 to .23 Ω-cm material. Constitutional supercooling occurred under some growth conditions with both materials and was sometimes severe enough to cause growth difficulties particularly with metallurgical grade silicon. The onset of morphological protuberance is sometimes triggered by β-SiC particles. Impurity characteristics are presented for the starting materials and for both smooth and constitutionally supercooled sheets. Also, relative concentrations of impurities in grain boundaries and in adjacent grains are given. Conventional diffused solar cells fabricated directly on the sheet attained antireflection coated AM1 efficiencies up to 6.3% for DAR metallurgical silicon and 3.4% for conventional metallurgical silicon. Other DAR cells achieved 4.7% AMO, non-AR coated efficiencies. Epitaxial layer solar cells achieved AM1, coated efficiencies up to 10.5% on DAR substrates and approximately 9% on conventional metallurgical substrates.

28401 **(SERI/TP—613-1225) Analysis of indium-phosphide/indium tin oxide solar cells.** Coutts, T.J.; Pearsall, N.M.; Nottenburg, R.; Ireland, P.J.; Kazmerski, L.L. (Solar Energy Research Inst., Golden, CO (USA); Newcastle upon Tyne Polytechnic (UK)). May 1981. Contract AC02-77CH00178. 7p. (CONF-810526—36). NTIS, PC A02/MF A01. Order Number DE81025907.

From 15. IEEE PV specialists conference; Orlando, FL, USA (11 May 1981).

The mechanisms are investigated that underlie the operation of p-InP/n-ITO solar cells fabricated by depositing thin films of ITO onto InP substrates by both RF sputtering and ion-beam sputtering. The RF sputtered devices behave like SIS or heterojunction cells. The ion-beam sputtered cells behave more like buried homojunction devices. It is shown that the properties of these cells depend not only on the method of fabrication, but also on several other complicating effects which occur before, during and after deposition of the ITO. (LEW)

28402 **(SERI/TP—614-1216) National photovoltaic program in amorphous materials.** Stone, J.; Sabisky, E.; Mahan, H.; McMahon, T.; Jeffrey, F. (Solar Energy Research Inst., Golden, CO (USA)). May 1981. Contract AC02-77CH00178. 6p. (CONF-810526—35). NTIS, PC A02/MF A01. Order Number DE81025906.

From 15. IEEE PV specialists conference; Orlando, FL, USA (11 May 1981).

Since the discovery that amorphous silicon prepared by plasma decomposition of silane produced a silicon-hydrogen alloy displaying characteristic doping, junction formation, and photovoltaic response, considerable national and international interest has been generated in pushing the understanding and development of this material. In 1978 the Department of Energy initiated a sponsored research program on amorphous materials which was subsequently transferred to the Solar Energy Research Institute (SERI). During the last two years the Program at SERI has grown and developed into a major program for the development of high efficiency (10% goal), cost effective (15-40 cents per peak watt goal), thin film solar cells. The status of this program, other research activities, and expected near term performance improvements are summarized.

28403 **(SERI/TP—614-1235) Thin-film polycrystalline silicon solar cells: progress and problems.** Surek, T.; Ariotedjo, A.P.; Cheek, G.C.; Hardy, R.W.; Milstein, J.B.; Tsuo, Y.S. (Solar Energy Research Inst., Golden, CO (USA)). May 1981. Contract AC02-77CH00178. 11p. (CONF-810526—37). NTIS, PC A02/MF A01. Order Number DE81025704.

From 15. IEEE PV specialists conference; Orlando, FL, USA (11 May 1981).

The progress in polycrystalline silicon solar cell research in areas of thin-film material and cell development, and in the basic understanding of the effects of grain boundaries and the passivation of these effects are reviewed. Current concerns in this area include the scalability of the more promising approaches, the reliability and stability of the cells and modules, and an assessment of the low-cost potential of the technologies. Recent progress in addressing these important problem areas is described.

28404 **(SERI/TP—623-1164) Biologically assisted photoelectrochemical cell.** Seibert, M.; Kendall-Tobias, M. (Solar Energy Research Inst., Golden, CO (USA)). Apr 1981. Contract AC02-77CH00178. 5p. (CONF-810526—33). NTIS, PC A02/MF A01. Order Number DE81025905.

From 15. IEEE PV specialists conference; Orlando, FL, USA (11 May 1981).

Chromatophore vesicles isolated from the photosynthetic bacterium Rhodospeudomonas sphaeroides R-26 were adsorbed as a film on SnO_2 electrodes and examined in a photoelectrochemical cell. The photovoltages and photocurrents generated by the cell under steady-state red light irradiation were dependent on the state of the chromatophores as modified by the chemical properties of the cell electrolyte including pH, salt concentration, redox couple, and redox potential. The cell was operable in the redox range where the c_2 cytochrome was reduced and the quinone pool was oxidized. Both these components are carriers in the cyclic electron

transport system of bacterial photosynthesis and must control electron transport between the chromatophore membrane and the electrodes.

28405 **(SERI/TR—734-762) Biomass feedstocks for petrochemical markets: an overview and case study.** Flaim, S.J.; Hill, A.M.; Lippe, D. (Solar Energy Research Inst., Golden, CO (USA); Pace Co. Consultants and Engineers, Inc., Houston, TX (USA)). May 1981. Contract AC02-77CH00178. 108p. NTIS, PC A06/MF A01. Order Number DE81027281.

A method of analysis is developed identifying several target chemicals for potential biomass feedstock substitution. An overview of the petroleum/petrochemical industries is presented and a general discussion of refinery trends. A case study of methanol production for formaldehyde manufacturing is presented. The technical, economic, and market implications of producing biomass-derived methanol for formaldehyde manufacturing appear highly favorable. The appendices provide general discussions of market and economic factors (e.g., supply and demand) for all petrochemicals with emphasis on the identified target chemicals.

28406 **(SERI/TR—8002-7-T2) Development of photoelectrochemical cells based on compound semiconductors and nonaqueous electrolytes. Final report, May 1, 1979-April 30, 1980.** Rauh, R.D. (Solar Energy Research Inst., Golden, CO (USA); EIC Labs., Inc., Newton, MA (USA)). Oct 1980. Contract AC02-77CH00178. 63p. NTIS, PC A04/MF A01. Order Number DE81025647.

Factors limiting the performance of nonaqueous photoelectrochemical cells (EPCs) have been delineated for a model photoelectrode, n-GaAs, in a variety of solvent-electrolyte combinations. Although a wider range of stabilizing redox systems can be identified in nonaqueous solvents than in H_2O, the lack of specific adsorption of the redox systems still limits maximum open circuit voltages to <0.7V. Because of solubility and electrolyte conductivity is found to be the CH_3CN, I_3^-/I^- system for n-GaAs. EPCs using this electrolyte have been characterized in detail. Development of less optically dense electrolytes is also being pursued. Truly anhydrous solutions of Cu and Cr perchlorates have been formed by in situ anodic dissolution of the parent metals. A parallel study of thin film photoelectrode structures has been conducted to demonstrate nonvacuum deposition methods: screen printing, electroless chemical plating, and electrochemical plating of Cd chalcogenides.

28407 **(SERI/TR—8104-4-T3) Low-cost process for p-n junction type solar cell. Final report, September 1, 1980-February 28, 1981.** Mooney, J.B.; Lamoreaux, R.H.; Bates, C.W. Jr. (Solar Energy Research Inst., Golden, CO (USA); SRI International, Menlo Park, CA (USA); Stanford Univ., CA (USA)). Feb 1981. Contract AC02-77CH00178. 107p. NTIS, PC A06/MF A01. Order Number DE81026049.

Low-cost manufacturing methods have been studied for two types of thin-film solar cells on glass substrates. One is a heterojunction CdS/$CuInSe_2$ deposited by chemical spray pyrolysis; the other is a CdS/CdTe cell that is prepared by silk screening and sintering. In the spray pyrolysis program, we have succeeded in deposition CdS layers that, after a brief heat treatment in N-Cd atmosphere, have a resistivity of less than 0.1 Ω-cm. We have also spray-deposited $CuInSe_2$ films that after a brief heat-treatment exhibit the desired chalcopyrite structure. Heterojunctions with photovoltaic response were produced by spray pyrolysis. The fill factors were low; consequently, the efficiency was less than 1%. The conditions for heat-treatment of the two layers of the heterojunction are mutually incompatible, and the resistance of the CdS layer increases during the $CuInSe_2$ deposition. Also, the condition for the conversion of the sphalerite to chalcopyrite seems to destroy the junction. A chemical thermodynamic study of the spray pyrolysis process has been useful in understanding and directing the spray pyrolysis program. The sintered cells are prepared by first applying a CdS layer containing a $CdCl_2$ flux and $GaCl_2$ dopant to a borosilicate glass substrate. The layer is sintered in a N-Cd atmosphere, then a CdTe layer (also containing $CdCl_2$ flux) is applied and sintered in nitrogen. The CdTe is converted to p-type by immersion in a CuCl solution. Metallic paint electrodes are then applied. We have obtained photovoltaic response with V/sub oc/ ranging up to 0.6 V, but with low I/sub sc/ and fill factor, and consequent low efficiency. The major problems appear to be in CdS film density and in junction deliniation.

28408 **Stabilization of n-CdSe photoanodes in nonaqueous Fe(NC)/sub 6//sup 3-/4-/ electrolytes.** Noufi, R.; Tench, D.; Warren, L.F. (Rockwell Int, Thousand Oaks, Calif). *Journal of the Electrochemical Society ;* **127**: No. 12, 2709-2713(Dec 1980).

The systematic development of a nonaqueous ferro-ferricyanide electrolyte for stabilization of n-CdSe photoanodes is described. Selection of the solvent is discussed in terms of inherent stability provided, the rate of the redox reaction, the tendency toward specific adsorption of the redox species, and the equilibrium potential of the redox couple with respect to the flatband potential (attainable open-circuit voltage). Results are presented for cells of the type n-CdSe/methanol/Fe (CN)/sub 6//sup 3-/4-//Pt which have been operated for up to 700 hr at 6 mA/cm/sup 2/ with no detectable degradation in either the electrode surface or the photoresponse. 19 refs.

28409 **Substrate heating and emitter dopant effects in laser-annealed solar cells.** Young, R.T.; Wood, R.F.; Christie, W.H.; Jellison, G.E. Jr. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Applied Physics Letters ;* **39**: No. 4, 313-315(15 Aug 1981).

This letter provides the first experimental evidence that substrate heating during pulsed-laser annealing (PLA) of ion-implanted silicon can significantly improve the electrical properties of the laser recrystalized region due to the reduction of the regrowth velocity. It is also shown that by using the optimum PLA condition, the open-circuit voltage V/sub OC/ and the fill factor of ion-implanted, laser-annealed solar cells are improved by increasing the emitter dopant concentrations, whereas the short-circuit current J/sub SC/ remains fairly constant, results which are in qualitative agreement with theoretical predictions.

28410 **Image force effects on carrier collection in a-Si:H solar cells.** Han, M.; Anderson, W.A.; Lahri, R.; Coleman, J. (Department of Electrical Engineering, State University of New York at Buffalo, 4232 Ridge Lea Road, Amherst, New York 14226). XS-9-8041-9. *Applied Physics Letters ;* **39**: No. 4, 325-327(15 Aug 1981).

A modified carrier collection model of a-Si:H Schottky-barrier solar cells is proposed to explain the falloff of short wavelength carrier collection efficiency. Schottky-barrier lowering due to image force effects alters the potential distribution near the metal-semiconductor interface. This altered potential decreases the carrier collection in a-Si:H solar cells by as much as 30%. Design considerations to improve carrier collection efficiency are also proposed.

28411 **Submicron polycrystal silicon film solar cells.** Fang, P.H.; Schubert, C.C.; Kinnier, J.H.; Pang, D. (Boston College, Chestnut Hill, Massachusetts 02167). N/A. *Applied Physics Letters ;* **39**: No. 3, 256-257(1 Aug 1981).

A silicon polycrystal thin-film solar cell with a present efficiency of 1% is reported. The process involves depositing a silicon film by electron beam evaporation on metal layers with steel as the substrate. The thickness of the p-i-n structure is about 5 μm. The grain size is of the order of several hundred angstroms. Some similarities of this submicron silicon with amorphous silicon are discussed.

28412 **Observation of grain boundary hydrogen in polycrystalline silicon with Fourier transform infrared spectroscopy.** Ginley, D.S.; Haaland, D.M. (Sandia National Laboratories, Organization 5154, Albuquerque, New Mexico 87185). DE-AC04-76-DP00789. *Applied Physics Letters ;* **39**: No. 3, 271-273(1 Aug 1981).

Fourier transform infrared spectroscopy has been applied to the study of polycrystalline silicon samples previously exposed to rf- and dc-induced hydrogen plasmas. The first direct observation of hydrogen incorporated in the grain boundaries has been made. Peaks attributable to surface hydrogen have also been observed.

The techniques developed show considerable utility in probing the very small numbers of impurity atoms in grain boundaries.

28413 **Thermal stability of titanium nitride for shallow junction solar cell contacts.** Cheung, N.W.; von Seefeld, H.; Nicolet, M.; Ho, F.; Iles, P. (California Institute of Technology, Pasadena, California 91125). *Journal of Applied Physics ;* **52**: No. 6, 4297-4299(Jun 1981).

To demonstrate the thermal stability of titanium nitride as a high-temperature diffusion barrier, the TiN-Ti-Ag metallization scheme has been tested on shallow-junction (~2000 A) Si solar cells. Electrical measurements on reference samples with the Ti-Ag metallization scheme show serious degradation after a 600 °C, 10-min annealing. With the TiN-Ti-Ag scheme, no degradation of cell performance is observed after the same heat treatment if the TiN layer is > or ≈1700 A. The glass encapsulation of cells by electrostatic bonding requires such a heat treatment.

28414 **Solar energy breeders.** Grimmer, D.P. (Los Alamos Sci Lab, NM). *Solar Energy ;* **26**: No. 1, 49-53(1981).

The amount of energy produced by a solar conversion device (SCD) breeder at various temperatures is examined, in addition to the simple energy quantity produced over a solar collector lifetime. Capacity breeding rates are calculated for both SCDs producing electricity intrinsically (e.g. photovoltaics) and for SCDs producing both electricity and a significant amount of thermal energy (e.g. total solar energy systems). 15 refs.

1406 Photovoltaic Power Systems

28415 **(DOE/ET/20279—110) Photovoltaic operations manual radio station WBNO.** Klein, D.N. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). Mar 1981. Contract AC02-76ET20279. 124p. NTIS, PC A06/MF A01. Order Number DE81027439.

The photovoltaic system operator is provided with the information needed to return to normal operation if the system has shut down and to maintain it in good operating condition. Appropriate safety information is provided for personal and equipment safeguarding. The site and equipment are briefly described. (LEW)

28416 **(DOE/JPL/955893—81/1) Integrated residential photovoltaic array development. Quarterly report No. 1.** (AIA Research Corp., Washington, DC (USA)). 10 Apr 1981. Contract NAS-7-100-955893. 63p. NTIS, PC A04/MF A01. Order Number DE81026583.

Sixteen conceptual designs produced by eight teams are described. Each design concept was evaluated by an industry advisory panel using a comprehensive set of technical, economic and institutional criteria. Key electrical and mechanical concerns that affect further array sub-system development are also discussed. Three integrated array design concepts were selected by the advisory panel for further optimization and development. From these concepts a single one will be selected for detailed analysis and prototype fabrication. The three concepts selected are the following: (1) an array of frameless panels/modules sealed in a T shaped zipperlocking neoprene gasket grid pressure fitted into an extruded aluminum channel grid fastened across the rafters; (2) an array of frameless modules pressure fitted in a series of zipperlocking EPDM rubber extrusions adhesively bonded to the roof. Series string voltage is developed using a set of integral tongue connectors and positioning blocks; (3) an array of frameless modules sealed by a silicone adhesive in a prefabricated grid of rigid tape and sheet metal attached to the roof.

28417 **(DOE/NASA/20485—10) Design description of the Schuchuli village photovoltaic power system.** Ratajczak, A.F.; Vasicek, R.W.; DeLombard, R. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). May 1981. Contract AI01-76ET20485. 95p. (NASA-TM—82650). NTIS, PC A05/MF A01. Order Number DE81027595.

The engineering design of a stand-alone photovoltaic (PV) power system for the village of Schuchuli (Gunsight), Arizona, on the Papago Indian Reservation is described. The purpose of this experiment was to demonstrate that a stand-alone photovoltaic power system could provide dependable power for basic human needs in a remote village environment. The power system was designed as a limited energy, all 120-V(d.c.) system to which loads cannot be arbitrarily added. The system consists of a 3.5-kW (peak) PV array, 2380 ampere-hours of battery storage, an Electrical Equipment Building, a 120-V(d.c.) electrical distribution network, and equipment and automatic controls to provide control power for pumping water into an existing water system; operating 15 refrigerators, a clothes washing machine, and a sewing machine in the Domestic Services Building; and lights for each of the homes and communal buildings. In addition, a solar hot water heater was provided to supply hot water for the washing machine and communal laundry. The system employs automatic control systems which provide voltage control by limiting the number of PV strings supplying power during system operation and battery charging, and load management for operating high priority loads at the expense of low priority loads as the main battery becomes depleted. The engineering design includes loads profiles and loads descriptions; an explanation of the PV array and battery sizing methodology; descriptions of the mechanical designs; electrical designs and descriptions of the array, battery, controls, instrumentation and distribution system; and a discussion of safety features.

28418 **(SAND—80-7014-3) Conceptual design and system analysis study for a hybrid solar photovoltaic/solar thermal electric power system. Volume III. Appendices. Final report.** (Sandia National Labs., Albuquerque, NM (USA); Spectrolab, Inc., Sylmar, CA (USA)). Jul 1981. Contract AC04-76DP00789. 169p. NTIS, PC A08/MF A01. Order Number DE81027362.

An analysis was done of hybrid photovoltaic/solar thermal electric conversion systems. The study compared several types of hybrid systems, photovoltaic-only systems, and solar thermal electric systems in terms of performance and cost. This study and its results are reported in detail in Volume II, and are summarized in Volume I. This third volume consists entirely of supporting appendices, including a description of the computer code used in the analyses and background information on heat engines, thermal efficiencies of photovoltaic thermal collectors, and optical considerations for central receiver plants.

28419 **(SAND—80-7175) Study of potential photovoltaic/thermal applications in the commercial sector. Final report.** Parker, C.D.; Whisnant, R.A.; Ferrell, G.C.; Hamlin, R.V. (Sandia National Labs., Albuquerque, NM (USA); Research Triangle Inst., Research Triangle Park, NC (USA)). Jul 1981. Contract AC04-76DP00789. 153p. NTIS, PC A08/MF A01. Order Number DE81027479.

To identify the most promising applications for photovoltaic-thermal (PV/T) systems, a procedure has been evolved for ranking applications in the service, commercial, and institutional (SCI) sectors by using FEA's Energy Consumption Data Base, which tabulates energy use by sector, region, fuel type, and end use. Ranking takes into account such factors as temperature requirements of end-use, effects of temperature on efficiencies, cost of fuels replaced, and thermal and electrical loads. The electrical load and the temperature requirement of the thermal load determine size of the array, which meets the requirements of the entire electrical load. Hospitals and nursing homes, public office buildings, and schools rank high as potential applications. The rankings also indicate the PV/T arrays are more cost-effective than PV-only arrays for most commercial applications. Heating and cooling load profiles are determined for a hospital, a high school, and a shopping center, each in a different location; absorption cooling can usually be substituted for vapor-compression cooling. The high school load profiles are used as a case study of a PV/T array application in several energy cost scenarios. The analysis shows the PV/T array can be used advantageously in each scenario considered.

28420 **(SAND—81-7016) Investigation of a family of power conditioners integrated into the utility grid: topical report.** Eckhouse, S.A. (United Technologies Corp., South Windsor, CT (USA). Power Systems Div.). Jun 1981. Contract AC04-76DP00789. 84p. NTIS, PC A05/MF A01. Order Number DE81027477.

The conceptual design of a power conditioner for residential size solar photovoltaic applications is described and the ac and dc interface requirements are discussed. The conceptual design includes a simplified schematic, mechanical layout, and functional description. Performance and efficiency projections, and cost and reliability estimates are given.

1407 Solar Thermal Power Systems

REFER ALSO TO CITATION(S) 28418, 28472, 28485

28421 (ATR—76(7506-05)-1) Solar thermal-conversion mission analysis. (Aerospace Corp., El Segundo, CA (USA)). 1 Sep 1975. Contract AM03-76SF01101. 298p. NTIS, PC A13/MF A01. Order Number DE81026935.

The Aerospace Corporation is carrying out analyses of conceptual systems, missions, and economic factors governing the generation of power by solar thermal conversion techniques. These analyses have addressed large (greater than 100 MW) central solar power plants intended solely for electric power generation. They have also considered the application of smaller (0.01 to 10 MW) total energy systems which supply both electrical energy and sensible heat to buildings varying in size from individual dwellings to large commercial complexes. Interim results are presented. Included are discussions of demand, siting, and system conceptualization for the solar total energy systems and of demand projection, system performance, modeling, and costing for the solar central power concept.

28422 (ATR—76(7523-02)-3) Highlights of the solar thermal conversion program. Semi-annual review, 30 April-2 May 1975. Finlayson, F.C. (Aerospace Corp., El Segundo, CA (USA). Energy and Transportation Div.). Jul 1975. Contract AT03-76CS51101. 87p. NTIS, PC A05/MF A01.

Overviews of the ERDA and Electric Power Research Institute program plans and the progress in the mission analysis study by the Aerospace Corporation are given. The total energy, distributed collector, surface technology, and central receiver studies are summarized briefly. Informal oral comments, recommendations, and conclusions of the Ad Hoc Review Committee relative to the information presented at the review are compiled. (LEW)

28423 (DOE/ET/20422—T1) Central-receiver solar-thermal power system, Phase 1. (Martin Marietta Corp., Denver, CO (USA)). 1976. Contract AC03-76ET20422. 240p. NTIS, PC A11/MF A01. Order Number DE81024336.

The 1 MW system and its tests are summarized. The Central-Receiver Solar-Thermal Power System program schedule is given. The 10 MWe pilot plant program, the computer simulation, cold start, insolation measurements, receiver solar power input profiles, and cost analysis in particular, are summarized, and the various subsystems are outlined. These are the collector, receiver, thermal storage, and electric power generation subsystem. Architecture and engineering aspects are included. (LEW)

28424 (DOE/ET/20424—T10) Central-receiver solar-thermal power system. Collector subsystem research experiments. Conceptual design report. (Boeing Engineering and Construction Co., Seattle, WA (USA)). 24 Sep 1975. Contract AC03-76ET20424. 78p. (D—277-10004-1). NTIS, PC A05/MF A01. Order Number DE81026461.

The research experiment conceptual design and tests were planned to provide design verification and supporting data, with test hardware which either duplicates or closely simulates the Pilot Plant preliminary design baseline. The conceptual design of the research experiment hardware, test plans and preliminary test results are presented. The conceptual design collector subsystem includes a reflective assembly, a transparent enclosure assembly, and a drive and control assembly, each of which is described. The temperature relationships between various components of the heliostat are given for a steady state environment as a function of outside ambient temperature, and component temperature variations throughout a daily cycle are given. (LEW)

28425 (DOE/ET/20424—T11) Central-receiver solar-thermal power system. Collector subsystem preliminary design baseline report. (Boeing Engineering and Construction Co., Seattle, WA (USA)). 24 Sep 1975. Contract AC03-76ET20424. 151p. (D—277-10003-1). NTIS, PC A08/MF A01. Order Number DE81026460.

The performance requirements for the collector subsystem and its three assemblies (enclosure, reflector, and drive and control), interface requirements, heliostat field performance analyses, design studies on the assemblies, and thermal design are discussed at length. Plans for installation and maintenance are described. Electrical and mechanical support equipment are listed, and safety considerations are summarized. (LEW)

28426 (DOE/SF/01178—T12) Statement of capabilities: 5-Megawatt Solar-Thermal Test Facility. (California State Government, Sacramento (USA); Black and Veatch, Kansas City, MO (USA); Georgia Inst. of Tech., Atlanta (USA); Honeywell, Inc., Minneapolis, MN (USA). Systems and Research Center). Jul 1975. Contract AC03-76SF01178. 16p. NTIS, PC A02/MF A01. Order Number DE81026887.

The 5-MW Solar Thermal Test Facility will have the capability of evaluating the performance of subsystems in a central receiver solar-electric generating system. The receiver subsystem may be of the exposed-surface or cavity-type, receive solar flux from a heliostat array varying from a 90 to 360-degree field, and operate a water-steam Rankine cycle under a variety of conditions. Expansion of the facility would permit testing advanced receiver concepts using the Brayton or combined Brayton and Rankine cycles and heat transfer fluids, such as air, helium, liquid metals, and molten eutectic salts. Heliostat subsystem tests include determinations of image size, shape, and brightness as functions of distance, time, and environmental conditions. The thermal storage subsystem may be tested as individual modules or as a combined and complete subsystem interfacing with the receiver and the steam turbine-generator unit. The test facility will have the capability of operating all subsystems simultaneously under all anticipated environmental and non-design conditions.

28427 (DOE/SF/01178—T13) Statement of capabilities: 5-Megawatt Solar-Thermal Test Facility. (California State Government, Sacramento (USA); Black and Veatch, Kansas City, MO (USA); Honeywell, Inc., Minneapolis, MN (USA). Systems and Research Center; Georgia Inst. of Tech., Atlanta (USA)). Aug 1975. Contract AC03-76SF01178. 40p. NTIS, PC A03/MF A01. Order Number DE81026888.

This report discusses the capabilities which the 5 MW Solar Thermal Test Facility must have to meet the needs of the national effort to develop solar thermal electrical power systems. To define these capabilities, the short and long range objectives of the facility have been identified. The fully operational facility will have the capability of testing receiver, heliostat, and thermal storage subsystems separately and as a completely integrated system. Additional capabilities to meet the needs for advanced systems testing, high temperature processing, and high temperature materials research will be implemented as demand and funding permit. The specific test capabilities required for the Pilot Plant Subsystem Research Experiments, advanced concepts, and other high temperature applications and the capabilities required to support these tests are described. Data supplied by the 10 MW Pilot Plant Phase I Contractors which support their testing requirements are included in the appendix to this report and the volume, Supplemental Data.

28428 (DOE/SF/10499—T36) 10 MWe solar thermal central receiver pilot plant solar facilities design integration, RADL Item 1-10. Technical status report. (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)). Aug 1980. Contract AC03-79SF10499. 16p. NTIS, PC A02/MF A01.

Accomplishments are reported in the areas of: program management, system integration, the beam characterization system, receiver unit, thermal storage subsystem, master control system, plant support subsystem and engineering services. A Solar Facilities Design Integration Program Action Items update is included. Cost underruns are discussed. (LEW)

28429 **(DOE/SF/10499—T40) 5-Megawatt solar-thermal test facility: conceptual field design.** (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA); Black and Veatch, Kansas City, MO (USA); Honeywell, Inc., Minneapolis, MN (USA). Systems and Research Center; Georgia Inst. of Tech., Atlanta (USA)). 8 Dec 1975. Contract AC03-79SF10499. 73p. NTIS, PC A04/MF A01. Order Number DE81026167.

Matrices of efficiency coefficients as functions of sun elevation and azimuth were determined for various field designs by using a ray trace code for simulating central receivers. The matrices were then combined with 1962 Albuquerque weather data to determine test duration curves for each field design that appeared promising. The results of heliostat field conceptual design using the ray trace code simulation is presented as a series of graphs which are grouped as clear air model graphs or annual test duration curves. (LEW)

28430 **(DOE/SF/10735—T1) Solar industrial retrofit study.** Rozenman, T. (PFR Engineering Systems, Inc., Marina Del Rey, CA (USA)). 29 Feb 1980. Contract AC03-79SF10735. 62p. (SAN—0735-7). NTIS, PC A04/MF A01. Order Number DE81026262.

The following are described: the system requirement specification; system configuration selection; conceptual design; process design; heliostat field optimization; receiver design; mechanical and structural design; plant operation, interface, and control; and transfer lines piping design. (MHR)

28431 **(DOE/SF/10739—T4) Saguaro power plant solar repowering project.** (Arizona Public Service Co., Phoenix (USA)). Mar 1980. Contract AC03-79SF10739. 78p. NTIS, PC A05/MF A01.

The subsystem characteristics, design requirements, and system environmental requirements for the Saguaro Power Plant Solar Repowering Project are defined. The plant conceptual design, performance, and economic data to be provided for the solar additions are identified as well as certain design data for the existing plant. All of the 115 MWe net No. 1 steam-Rankine unit of the Saguaro station is to be repowered. The receiver heat transport fluid is draw salt (60% sodium nitrate and 40% potassium nitrate) that is also used to provide 4 hours of sensible heat storage. The receiver is quad-cavity type, and there is a field of 10,500 second generation heliostats. (LEW)

28432 **(MCR—76-298) 1-MWth bench-model solar-cavity-receiver steam generator build and test.** (Martin Marietta Aerospace, Denver, CO (USA)). Aug 1976. Contract AC03-76ET20183. 57p. NTIS, PC A04/MF A01.

The purpose of the study presented in this report was to define the modifications required to the 1-MW/sub th/ solar cavity steam generator system to permit its testing in the 5-MW Thermal Solar Test Facility at the Sandia Laboratories, Albuquerque, New Mexico. Analyses were performed to evaluate solar flux intensities and energy distributions within the receiver cavity when exposed to the concentrated solar flux reflected by the 78 heliostats in the collector field. These analyses indicated that it was feasible to decrease absorbed flux intensity and distribute properly the solar energy within the cavity by coating with white paint selected regions of the boiler and superheater. A preliminary investigation of the receiver start-up sequence at the test facility was made. Additional instrumentation for the test was identified and the need to replace the feedwater heater/desuperheater flow control valves was established. A preliminary design of the receiver modifications was performed. This includes an insulated door for the receiver aperture and a protective system designed to absorb the energy around the receiver aperture and provide a means to quickly intercept the solar flux during flux measurements and emergencies. Installation of the 1-MW/sub th/ receiver system at the test facility tower was investigated and a preliminary layout of the equipment was made.

28433 **(MCR—79-1354) SRE receiver subsystem experiment: solar test procedure.** Lowrie, A.R. (Martin Marietta Corp., Denver, CO (USA)). Jul 1979. Contract AC03-76ET20422. 127p. NTIS, PC A07/MF A01.

The receiver to be tested is described. The requirements for receiver valve positioning prior to and during receiver startup are defined. The shutdown procedures at the end of the day or at the termination of a solar operation will be conducted by one of two methods. The first is for a normal shutdown and will be utilized to maintain a hot steam drum in order to conduct a hot restart at the next operation. When it is necessary to cool the receiver rapidly, the blowdown option will be used. The test procedures and data necessary to conduct solar testing are given. The tests include increasing power level operations, heliostat combination tests, cold start and hot restart procedures, cloud passage simulation and testing, steady state reduced power tests, maximum solar day duration test and cooldown tests. (LEW)

28434 **(ORNL/TM—7441) Applications of high-temperature solar heat to the production of selected fuels and chemicals.** Beall, S.E. Jr.; Bamberger, C.E.; Goeller, H.A. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 134p. NTIS, PC A07/MF A01. Order Number DE81027070.

An attempt is made to judge whether solar heat in the 500 K to 2500 K temperature range might be economical for some important fuel- and chemical-production processes. Previous work in related areas is reviewed and the chemicals aluminum oxide (and bauxite), calcium sulfate (and gypsum), and calcium oxide (lime) chosen for detailed study. In addition to reviewing the energy needs of the more common bulk chemicals, several innovative processes requiring heat in the 1500 to 2500 K range were investigated. Hydrogen production by several thermochemical means, carbon monoxide production by thermochemical and direct thermal dissociation, and nitrogen fixation by direct thermal reaction of nitrogen and oxygen in air were considered. The engineering feasibility of the processes is discussed. The problem of matching the conventional and innovative processes to a high-temperature solar supply is studied. Some solar-thermal power plants of current designs are examined and several advanced concepts of highly concentrating systems are considered for very high-temperature applications. Conclusions and recommendations are presented.

28435 **(RFP-EG—77-R-03-1468) Central-receiver solar-thermal power system. Phase I: 10-MW electric pilot plant.** (General Electric Co., Schenectady, NY (USA); Sandia Labs., Livermore, CA (USA)). Jan 1977. Contract AC03-77ET20436. 30p. NTIS, PC A03/MF A01.

The central receiver research program is described, including a list of the contractors involved and the project schedule. Conceptual design and estimated cost of a commercial plant are given, and testing is discussed. Characteristics of the preliminary designs under study by the contractors are listed, and simplified schematics of the systems are presented. Numerous illustrations are included. (LEW)

28436 **(SAND—78-8192) Second-generation heliostat detail design report.** Knowles, R.K. (McDonnell Douglas Corp., Huntington Beach, CA (USA)). Aug 1980. Contract AC04-76DP00789. 204p. (MDC-G—8631). NTIS, PC A10/MF A01. Order Number DE81025769.

An overview of the Second Generation heliostat design is provided, including a summary of the compliance of the design to the key heliostat requirements. The heliostat hardware is described. The requirements, the hardware and software design used to fulfill these requirements and the analysis and test used to evaluate related performance are presented. The technical feasibility and potential cost savings of a variety of automated mirror inspection techniques are assessed. The installation process design, applicable to both the test units and production, is described. The current maintenance process design is described for the production program. (LEW)

28437 **(SAND—79-8192-Vol.2) Second-generation heliostat development. Volume II. Detailed design report.** (Sandia National Labs., Livermore, CA (USA); Martin Marietta Corp., Denver, CO (USA)). Sep 1980. Contract AC04-76DP00789. 166p. (MCR—80-1369A). NTIS, PC A08/MF A01. Order Number DE81025684.

A drawing tree for the second generation heliostat assembly is shown. Structural data of the Rack Assembly, Drive Mechanism,

and Mirror Assemblies are presented and reference material for the discussions in the main section of the report is given. Tests that were performed to evaluate the materials selection for the mirror assembly are described, and their results are given. The design of the pedestal/foundation for the heliostat is summarized. A priced bill of materials, labor/tooling cost worksheets, and production cost worksheets used to derive the heliostat cost estimates are included. A design study shows that the edge-support mirror module is not weight and cost-effective, and the design chosen is described. (LEW)

28438 **(SAND—81-1546C) Non-solar power tests at the Central Receiver Tect Facility (CRTF).** Holmes, J.T. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 22p. (CONF-810469—2). NTIS, PC A02/MF A01. Order Number DE81026955.

From Solar Thermal Test Facilities Users Association annual business and technical meeting; Pasadena, CA, USA (20 Apr 1981).

In addition to programs to develop central receiver technology components, a number of other tests are summarized that use some of the unique capabilities of the CRTF. The three major non-central receiver component tests have been a Navy/Applied Physics Laboratory simulation of aerodynamics heating of a missile nose-cone, a Sandia-Rockwell International gallium arsenide photovoltaic array, and a DNA/Science Applications development of a secondary beam concentrator.

28439 **(SAND—81-1547C) Flux mapping at the CRTF.** Holmes, J.T. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 10p. (CONF-810469—4). NTIS, PC A02/MF A01. Order Number DE81026985.

From Solar Thermal Test Facilities Users Association annual business and technical meeting; Pasadena, CA, USA (20 Apr 1981).

The Central Receiver Test Facility uses an array of flux density sensors to measure the power and flux density distributions for major receiver test programs. A mechanical device, called the Real Time Aperture Flux system (RTAF), was used to move a row of individual sensors across the aperture of an air-cooled receiver and a molten salt cooled receiver. The RTAF moving bar system is described, and its control and data computer system are discussed. (LEW)

28440 **(SAND—81-1717C) Distributed computer control of the Central-Receiver Test Facility.** Davis, D.B. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 14p. (CONF-810623—11). NTIS, PC A02/MF A01. Order Number DE81027101.

From 24. midwest symposium on circuits and systems; Albuquerque, NM, USA (29 Jun 1981).

The computer-based control system is an overall command, control, and data system that performs facility management and supervision as well as data collection, analysis, and presentation. The system uses 10 minicomputers in a modular, function-oriented network. Besides the real time control and data requirements of the facility and experiments, there are background and off-line support tasks that are provided by ancillary systems. These include the focus and alignment subsystem and a meteorological sensor package. (LEW)

28441 **(SAND—81-8005) Solar power tower design guide: solar thermal central receiver power systems. A source of electricity and/or process heat.** Battleson, K.W. (Sandia National Labs., Livermore, CA (USA)). Apr 1981. Contract AC04-76DP00789. 162p. NTIS, PC A08/MF A01. Order Number DE81026584.

The information is provided that is necessary to perform preliminary evaluations of whether a solar thermal central receiver plant is technically and economically feasible, as well as desirable, for the potential user's application. The cost elements, performance, and operation of solar central receiver systems are described.

28442 **(SAND—81-8017) Nonlinear thermal and structural analysis of a brazed solar-central-receiver panel.** Napolitano, L.M. Jr.; Kanouff, M.P. (Sandia National Labs., Livermore, CA (USA)). Jul 1981. Contract AC04-76DP0789. 45p. NTIS, PC A03/MF A01. Order Number DE81025458.

One part of the evaluation program for a molten sodium central receiver was to be a test of a reduced-scale panel at Sandia's Central Receiver Test Facility in Albuquerque. The panel incorporates a new way of joining tubes - brazing to intermediate filler strips - which can affect the panel's lifetime. To calculate the stresses and strains for the worst-case section of the experimental panel, we have done a nonlinear elastic-plastic analysis with the MARC finite element computer code, which takes the temperature dependence of the material properties into account. From the results, tube design lifetimes are predicted. The analysis shows that concerns for cracking and reduction in lifetime are warranted, but a more detailed fracture analysis is necessary to determine whether there is a stable-crack-growth problem.

28443 **(SAND—81-8176Vol.1) Second-generation heliostat development. Final report.** (Martin Marietta Corp., Denver, CO (USA)). Apr 1981. Contract AC04-76DP00789. 229p. (MCR—81-1713). NTIS, PC A11/MF A01. Order Number DE81028791.

The detailed design of the second-generation heliostat is presented with the supportive analyses. Component and system test data are given. The preliminary design of the manufacturing plant is described. Costs to manufacture, transport, install and maintain 50,000 heliostats per year in 50-MWe fields are projected. Cost estimates are made on a worst-case basis. (LEW)

28444 **(SAND—81-8176Vol.2) Second-generation heliostat development. Final report.** (Martin Marietta Corp., Denver, CO (USA)). Apr 1981. Contract AC04-76DP00789. 200p. NTIS, PC A09/MF A01. Order Number DE81028792.

The design, manufacture, testing and cost analysis of the second generation heliostat are described in volume I. Volume II consists of appendices of supporting material. These include the drawing tree for the heliostat, structural data of the rack assembly, drive mechanism, and mirror assemblies, tests and results, a trade study on the pedestal foundation design, cost analysis worksheets, study of an edge-support mirror module, and a study of a single-motor, differential brake heliostat drive mechanism. (LEW)

28445 **(SAND—81-8178-Vol.4) Second-generation heliostat development. Volume IV. Appendices F to J. Final report, July 16, 1979-March 31, 1981.** (Sandia National Labs., Albuquerque, NM (USA); Northrup, Inc., Hutchins, TX (USA); Bechtel National, Inc., San Francisco, CA (USA); Booz, Allen and Hamilton, Inc., Cleveland, OH (USA)). Mar 1981. Contract AC04-76DP00789. 174p. NTIS, PC A08/MF A01. Order Number DE81028868.

The control software consists of two packages, one handling the external data processing, communication, and control and one handling the internal data processing, communication and direct motor control. The word structure used to communicate control information and status information between the two systems is defined. An overview flow diagram is provided for each package. Results of the electronic and mechanical tests are given and discussed at length. Cost summaries for the manufacturing process are given. The technical specification for installation of open end pipe piles is included. Surface preparation, application, and inspection of protective coatings for carbon steel heliostat piles are specified. (LEW)

28446 **(SAND—81-8227) Evaluation of inverted-stow capability for heliostats.** Kerstein, A. (Sandia National Labs., Livermore, CA (USA)). Jun 1981. Contract AC04-76DP00789. 24p. NTIS, PC A02/MF A01. Order Number DE81028203.

A previous assessment of the costs and benefits of inverted-stow capability is updated based on recent developments in heliostat design and washing cost estimation. The previously-estimated 12% cost advantage of non-inverting heliostats is found to be design-specific. The present analysis identifies circumstances in

which non-inverting and inverting designs may be evenly matched on a cost basis. Therefore, a clear preference between non-inverting and inverting designs cannot be established at this time.

28447 (SERI/TP—632-1287) Use of solar thermal energy to generate electricity. Murphy, L.M. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1981. Contract AC02-77CH00178. 22p. (CONF-810808—9). Dep. NTIS, PC A02/MF A01. Order Number DE81028797.

From Energy in the man-built environment: the next decade specialty conference; Vail, CO, USA (3 Aug 1981).

A brief overview is presented of solar thermal electric technology. Various technical approaches are discussed which result in net solar to electric conversion efficiencies ranging from less than 1% to more than 20%. The status of the various solar thermal electric concepts is discussed along with the principal areas of research for each respective concept. Finally, cost issues and prospects for the economic competitiveness of solar thermal electric systems with conventional systems are outlined.

28448 Energy transport system optimization for distributed networks of solar collectors. Barnhart, J.S. (Battelle, Pac Northwest Lab, Richland, Wash). *American Society of Mechanical Engineers, [Paper]* ; No. 80-Sol-7, vp(1980).

A computer program, ETRANS, was developed for optimizing the piping network associated with distributed networks of solar collectors. ETRANS employs frequently cited field layouts for dish and trough collectors. Using discrete piping component sizes, ETRANS determines realistic estimates of operating expenses and capital item costs. This paper describes the field layouts employed, the system performance calculations, and the costing methodology. 10 refs.

28449 Concept and implementation of the master control system for the solar 10 MWe pilot plant. Rountree, R.C.; Winarski, C.P. (Aerosp Corp, El Segundo, Calif). pp 50-67 of Instrumentation for energy-sources technology. Research Triangle Park, NC; ISA (1980).

From Energy-sources technology conference; New Orleans, LA, USA (3 Feb 1980).

A description is given of the MCS concept and the basis for its adoption in three steps and then culminates in an overview of current and expected implementation. First, a brief description of the Process and Power Plant Cycle is presented. A review is presented of the functional constraints and plant subsystem interactions imposed upon MCS Design. Next, a description of the MCS configuration is provided wherein the three primary MCS elements are defined first in terms of an overview and then together with the functions assigned to each; all are in direct response to the functional constraints and subsystem interactions. A summary is presented pertaining to the overall MCS configuration and its planned implementation. 2 refs.

28450 Simplified linear dynamic model for first-cut controller design of a solar-powered once-through boiler. Schiring, E.E. (The Aerospace Corp., El Segundo, CA); Rogers, R.O.; Riel, E.J.; Welch, A.J. pp 35-52 of Instrumentation in the power industry, Volume 23. Good, E.M. (ed.). Research Triangle Park, NC; Instrument Society of America (1980).

From 23. ISA power instrumentation symposium; Chicago, IL, USA (14 May 1980).

A simplified linear dynamic thermal hydraulic model of a once-through steam generator is presented. The model is a first-order transfer function with pure transport delay and with explicit analytical expressions for the model parameters. The intended use for the model is the initial design of an outlet steam temperature controller using inlet flow rate valve adjustment, where final controller gains can then be determined through a tuning process of detailed simulation, test, and operation. Model validation is accomplished by several approaches. First, a numerically derived higher order linear model frequency response is obtained from a nonlinear mathematical dynamic description based on established first principles techniques. The frequency response of this higher order linear model is shown to compare favorably to that of the simplified model, thereby providing analytical credence to the simplified model. Next, the frequency response of the simplified model is validated by direct comparison with frequency response test results obtained at the Department of Energy/Sandia Laboratories Central Receiver Test Facility. Finally, a description is given of a simplified model frequency response validation based on step response test results. The modeling and validation techniques should be applicable to similar initial controller design of other once-through boilers and to other similar processes.

1408 Ocean Thermal Gradient And Salinity Gradient Power Systems

28451 (ANL/OTEC-BCM—016) Special heat transfer monitor (HTM) for the Trane Company OTEC heat exchanger. Kuzay, T.M.; Panchal, C.B.; Gavin, A.P. (Argonne National Lab., IL (USA)). Feb 1981. Contract W-31-109-ENG-38. 73p. NTIS, PC A04/MF A01. Order Number DE81026505.

A Heat Transfer Monitor (HTM) is a sensitive device which quantifies development of biofouling in the OTEC heat exchanger surfaces in terms of degrading heat transfer coefficient as biofouling progresses. The Carnegie-Mellon University (CMU) type HTM has been successfully utilized to date for plain circular OTEC heat exchanger tubes. With the development of compact heat exchangers for OTEC with non-circular and/or complex tube geometries, a device independent HTM (Universal Monitor) concept is being sought. For the meantime, however, novel methods have been developed to extend the principles of the CMU type HTM to noncircular tube geometries. The theory, formulation, analytical solutions and laboratory test results are presented for the novel use of the CMU HTM concept with such a special tube for the Trane Company heat exchanger for OTEC.

28452 (ANL/OTEC-BCM—017) Sensitivity analysis for CMU type heat-transfer monitor for OTEC. Kuzay, T.M.; Bors, D.A. (Argonne National Lab., IL (USA)). Apr 1981. Contract W-31-109-ENG-38. 71p. NTIS, PC A04/MF A01. Order Number DE81026472.

Measurement of the fouling resistance, R/sub f/, by a Heat Transfer Monitor (HTM) has some inevitable uncertainty. To better understand the origins of such uncertainty, a sensitivity analysis of the data-reduction algorithm of the improved Agronne National Laboratory (ANL) HTM was performed. Nine parameters were chosen for analysis: tau, the time constant for the cooling curve; the seawater temperature; the flow velocity; the Wilson Plot slope and intercept; the inside diameter of the tube; the thermal conductivity of the tube; the correction factor for the thermal entrance effect; and the natural convection heat transfer coefficient for air. The first step in the analysis was to generate a set of uncertainty equations based on the partial derivatives of the equations in the data-reduction algorithm. Then, after all other uncertainties were set to zero, the uncertainty in the parameter being examined was allowed to vary. Each time, the corresponding uncertainty in the nominal fouling resistance was calculated. Also, a further study was undertaken to examine the effects of the uncertainty of the fouling factor caused by different values of the fouling resistance. As a result of this study, it was determined that the uncertainty in the fouling factor was highly sensitive to five parameters: tau, the flow velocity, the Wilson Plot slope, the correction for the entrance effect, and the water temperature. Small uncertainties in these values will result in relatively high uncertainties in the fouling resistance. Thus, the major causes for any high level uncertainties can be directly attributable to the uncertainties in a few specific parameters.

28453 (DOE/ET/20416—T3) Ocean thermal-energy-conversion power-system development. Phase I. Conceptual and preliminary design. Quarterly technical progress report, August 1-October 31, 1977. (Westinghouse Electric Corp., Lester, PA (USA). Power Generation Divs.). 1977. Contract AC03-77ET20416. 169p. NTIS, PC A08/MF A01. Order Number DE81026629.

Work on the development of a preliminary design of a closed-cycle ammonia power plant system module for the 100 MWe OTEC Demonstration Plant is reported. The analytical strategy for studying the system, parametric power system computer model, and module size selection are discussed. Hull and power

system arrangements and the interface between the power system and cold water pipe are described. The heat exchanger design, seawater pumps, piping, turbine, generator, control system and auxiliary systems are described. Continuing work on materials analysis, biofouling analysis and design, modular size and producibility, and system cost is reported. Reliability, availability, maintainability, and safety are discussed. (LEW)

28454 **(DOE/NOAA/OTEC—34(Vol.1)) OTEC large systems construction techniques.** (Delta Marine Consultants, Gouda (Netherlands)). 1981. Contract AI01-79CS20396. 460p. NTIS, PC A20/MF A01. Order Number DE81023735.

Requirements for the construction and installation of various types of 400 MWe OTEC commercial size platforms and cold water pipes are presented. The capability of the state of the art in Technologies and Facilities, to satisfy the requirements of OTEC commercial plant construction and installation are assessed.

28455 **(DOE/NOAA/OTEC—34(Vol.2)) OTEC large systems construction techniques.** (Delta Marine Consultants, Gouda (Netherlands)). Feb 1980. Contract AI01-79CS20396. 313p. NTIS, PC A14/MF A01. Order Number DE81023734.

A modified concept for a submerged type platform which suits better the US construction capabilities has been developed. Eight construction/installation plans for different combinations of platform, cold water pipe and operating location are presented; these construction/installation plans include time and cost estimates.

28456 **(LBL—12666) List of fish at a proposed OTEC site off Ke-ahole Point, Hawaii, derived from commercial fish records, 1959-1978.** Jones, A.T.; Ryan, C.J. (Lawrence Berkeley Lab., CA (USA)). May 1981. Contract W-7405-ENG-48. 14p. NTIS, PC A02/MF A01. Order Number DE81026277.

Fish species landed from an area encompassing a proposed Ocean Thermal Energy Conversion (OTEC) site off Ke-ahole Point, Island of Hawaii are presented. Over 60 species of fish representing 31 families recorded in the twenty years of commercial fish landings are listed with their scientific, local Hawaiian and common name.

28457 **(LBL—12902) Bibliography of marine turtles in Hawaii.** Payne, S.F. (Lawrence Berkeley Lab., CA (USA)). Jul 1981. Contract W-7405-ENG-48. 9p. NTIS, PC A02/MF A01. Order Number DE81028911.

Information on the organisms at proposed Ocean Thermal Energy Conversion (OTEC) sites is required to assess the potential impacts of OTEC power plant operations. This bibliography is the product of a literature survey on marine turtles at two proposed OTEC sites in Hawaii. The OTEC sites are located off Keahole Point, Hawaii and Kahe Point, Oahu. The references included in this bibliography provide information on the distribution, ecology and biology of marine turtles in Hawaii.

28458 **(LBL—12956) Commercial fishery data from three proposed OTEC sites.** Ryan, C.J.; Jones, A.T. (Lawrence Berkeley Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 9p. (CONF-810622—6). NTIS, PC A02/MF A01. Order Number DE81027213.

From 8. ocean energy conference; Washington, DC, USA (7 Jun 1981).

The operation of Ocean Thermal Energy Conversion (OTEC) power plants may affect fish populations in the regions surrounding the plants. As an initial step in estimating the possible impacts of OTEC power plants on local fishery resources at three proposed sites, commercial fishery records were used to identify common commercially-important species and to obtain a general impression of the abundance of those species at the sites. The sites examind are in the waters adjacent to Punta Tuna, Puerto Rico (PROTEC), and in the Islands of Hawaii offshore from Kahe Point, Oahu (O'OTEC) and Keahole Point, Hawaii (HOTEC).

28459 **(LBL—12963) OTEC environmental biological oceanographic program.** Hartwig, E.O. (Lawrence Berkeley Lab., CA (USA)). Jul 1981. Contract W-7405-ENG-48. 14p. (CONF-810622—7). NTIS, PC A02/MF A01. Order Number DE81027402.

From 8. ocean energy conference; Washington, DC, USA (7 Jun 1981).

One of the major goals of the OTEC biological field measurement program is to assess the effect of OTEC operations on the environment. Prior understanding of the natural variability of the tropical oceanic plankton community is the most important method for determining changes due to operation of an OTEC plant. The spatial and temporal patterns of the plankton community in terms of absolute number, biomass and species composition have been investigated at potential OTEC sites. Considerable data exist which document the changes with depth of all three measurements. Diel fluctuations in number and species composition have been studied at one site. While horizontal and seasonal patterns of variability likely exist at all sites, they are subtle and remain somewhat unclear. Attempts are now being made to determine the overall trophic structure of the plankton community at these sites using these data, gut content analysis, and information already in the literature.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 28064, 28378, 28419, 28430, 28434, 28434, 28438, 28892, 28892, 28915

28460 **(BNL—29677) DOE Solar-Assisted Heat-Pump program: its evolution and its potential.** Andrews, J.W. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH0016. 5p. (CONF-810912—10). NTIS, PC A02/MF A01. Order Number DE81026055.

From Active contractors' review meeting; Washington, DC, USA (Sep 1981).

Progress in the Solar Assisted Heat Pump program is described in terms of the progressive modification of original assumptions on the basis of accumulating experience. The ways in which these modifications have led to enhanced system potential are explained. A major impetus for progress has been the assimilation and reconciliation of divergent systems analysis results. Technical accomplishments in the program to date are described, and needed future activities are listed.

28461 **(BNL—29678) Solar heat pump simulator.** Catan, M.A. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 5p. (CONF-810912—3). NTIS, PC A02/MF A01. Order Number DE81024368.

From Active contractors' review meeting; Washington, DC, USA (Sep 1981).

The simulator was utilized to provide controlled-temperature sources and sinks to an experimental water-to-water laboratory heat pump test bed. This combination was used to demonstrate and explore the potential of the vapor-compression cycle to deliver high COP's at SAHP source temperatures. Results from the simulator were used in computer simulations of complete systems performed by BNL, by the SAHP contractors, and by others. The Lennox 2-speed compressor was first tested at high source temperatures on the BNL simulator. In view of the decision by both contractors to construct water-to-air (rather than water-to-water) heat pumps, the BNL simulator was fitted with an air-side test loop. The Northrup prototype heat pump has been tested under steady-state conditions on the BNL simulator.

28462 **(CDRL/PA—10) Application of solar energy to the supply of industrial-process hot water.** (Acurex Corp., Mountain View, CA (USA)). Jan 1977. Contract AC03-76CS31218. 363p. NTIS, PC A16/MF A01. Order Number DE81023625.

The Solar System described was designed for installation at the Campbell Soup plant in Sacramento, where the solar heated water will be used to wash empty and full soup cans on a soup filling line. The detailed design and analysis of the solar energy hot water system for incorporation into the selected industrial process are described. Appendix A is a copy of the Preliminary Design and Performance Report and Appendix B is a copy of the energy Re-

duction and Economic Analysis Report. Detail drawings of the Solar System appear in Attachment 2.

28463 **(DOE/CE/20418—1) Minimum energy dwelling. Final report I.** (Southern California Gas Co., Los Angeles (USA); Mission Viejo Co., CA (USA); Burt-Hill-Kosar-Rittelmann Associates, Washington, DC (USA)). Jul 1981. Contract AC03-78CS20418. 245p. NTIS, PC A11/MF A01. Order Number DE81027556.

Analyses and results of the Minimum Energy Dwelling project are presented. The two detached single family dwellings in the Mission Viejo community in California have been monitored for the temperature and flow rate of water and air at some 45 points throughout the domestic hot water, mechanical conditioning, and solar energy systems. On site weather data has been collected since operation began. Testing of levels of odor and moisture was performed to determine the effect of the tighter than average construction methods used in the MED houses. Electric consumption data for the mechanical system and household consumption has been recorded separately. Utility cost records have been maintained as a measure of savings between the MED houses and the standard Cordova model. The designers of the Minimum Energy Dwelling have written a MED Workbook to record and communicate the energy saving techniques investigated during the design process. Visitors to the Minimum Energy Dwelling demonstration unit have been interviewed and their opinions recorded and analyzed as a measure of public opinion and interpretation of the various energy conserving features of the project. A summary of these activities are presented. (MCW)

28464 **(DOE/CS/30214—T1) Design and demonstration tests of a steam turbine for solar cooling. Final report, September 19, 1977-November 31, 1980.** (Energy Technology, Inc., Cleveland, OH (USA)). 1980. Contract AC03-80CS30214;AC03-77CS34543. 91p. NTIS, PC A05/MF A01. Order Number DE81026873.

Work on the design and testing of a dual heat source solar Rankine turbine engine is described. The dual heat source Rankine cycle engine was investigated in order to demonstrate the high performance capability of the design and to show its applicability to commercial air-conditioning systems. The design of the steam turbine solar cooling system is described fully in this report. Turbine test results are also given. This test turbine was designed to produce 31 horsepower at a design speed of 75,000 RPM to drive a solar cooling system of nominal 30 tons capacity. A solar collector requirement of 55 square feet/ton of cooling was projected, if 20% of the annual energy supplied is at 1000°F. The initial turbine design point efficiency estimate was 78%.

28465 **(DOE/CS/31218—T2) Application of solar energy to the supply of industrial-process hot water. Phase III: cost estimate.** (Acurex Corp., Mountain View, CA (USA)). Dec 1976. Contract AC03-76CS31218. 14p. NTIS, PC A02/MF A01. Order Number DE81023623.

Acurex's plan and cost estimate for accomplishing Phase III of the ERDA Solar Industrial Process Hot Water Program. Phase III will be an operation and evaluation program for the solar water heating system installed by Acurex at the Campbell Soup plant in Sacramento, California. The proposed program will last 15 months, with a total preliminary estimated cost of $156,773. The anticipated start date is November 1, 1977. The program plan and schedule, and the cost summary are given.

28466 **(DOE/CS/31219—T1Vol.1) Application of solar energy to the supply of industrial hot water. Volume 1. Preliminary design report.** (Jacobs Engineering Co., Pasadena, CA (USA)). 15 Oct 1976. Contract AC03-76CS31219. 231p. NTIS, PC A11/MF A01. Order Number DE81023620.

Work is reported on a system for providing solar hot water and steam to a laundry facility in El Centro, CA. A two-dimensional parabolic tracking collector is used. A process analysis was done to determine the hourly, daily, and annual usage of process hot water, steam, energy to generate hot water and steam, and purchased energy required by the conventional natural gas/oil boiler plant. Direct normal solar radiation was measured in El Centro in conjunction with solar collector tests in May and June, and values for the balance of the year were extrapolated. These data were compared with values for Albuquerque and Omaha. The design of the hot water and steam system and the waste heat reclamation system is described, and sizing of collector arrays and the analysis of storage capacities are discussed. Some heat transfer fluids and thermal insulation are analyzed. The design of the plumbing, heat exchangers, control and electrical systems is presented and maintenance is discussed. Economic analyses are performed. (LEW)

28467 **(DOE/CS/31219—T1Vol.2) Application of solar energy to the supply of industrial hot water. Volume 2. Appendix to preliminary design report.** (Jacobs Engineering Co., Pasadena, CA (USA)). 15 Oct 1976. Contract AC03-76CS31219. 476p. NTIS, PC A21/MF A01. Order Number DE81023621.

Appendices of miscellaneous supporting material for Vol. 1, which describes a solar process heat for a laundry facility, are given. These include: a detailed description of the solar collector; calculations from the process analysis; insulation data; design drawings, data and information; a description of instrumentation; structural data; a list of key personnel; the economic analysis and supporting materials; construction plans; cost data; and the Jacobs Engineering Group Inc. 1975 annual report. (LEW)

28468 **(DOE/NASA/CR—161797) Solar heating and hot water system installed at Arlington Racquetball Club, Arlington, Virginia. Final report.** (ARC Associates, Arlington, VA (USA)). May 1981. Contract FC01-78CS35211. 99p. NTIS, PC A05/MF A01. Order Number DE81027694.

The solar energy system consists of 2520 sq. ft. of flat plate solar collectors and a 4000 gallon solar storage tank. The transfer medium in the forced-closed loop is a non-toxic antifreeze solution (50% water, 50% propylene glycol). The service hot water system consists of a preheat coil (60 ft. of 1 1/4" copper tubing) located in the upper third of the solar storage tank and a recirculation loop between the preheat coil and the existing electric water heaters. The space heating system consists of two (2) separate water-to-air heat exchangers located in the ducts of the existing space heating/cooling systems. The heating water will be supplied from the solar storage tank. This report includes extracts from site files, specification references for solar modifications to existing building heating and hot water systems, drawings installation, operation and maintenance instructions.

28469 **(DOE/NASA/CR—161802) Solar domestic hot water system manual for Day's Inn, Garland, Texas.** (Day's Inn of America, Inc., Atlanta, GA (USA)). May 1981. Contract FG01-77CS31632. 36p. NTIS, PC A03/MF A01. Order Number DE81027874.

The solar domestic hot water system installed at Day's Inn, I-30 and 6222 Beltline, Garland, Texas is described. The system is a solar collector array used to provide from 39.9% in December, to 84.7% in August, of the domestic hot water usage of the Day's Inn in Garland, Texas. The system is an automatic draindown design employing an atmospheric vented storage tank for storing the hot water collected by the 998 sq. ft. collector array. The system's major components and features are: 44 Daystar 1400 collectors, gross square footage of 998 sq. ft.; 1000 gallon vented storage tank; 3 B and G pumps: one for the collection loop, one for transfer of energy from the thermal storage tank to the shell side of the B and G heat exchanger; the third to circulate water from the three existing DHW tanks through the tube side of the heat exchanger; 3 one-inch Taco automatic valves to control the heating of water through existing DHW tanks; vacuum breakers to ensure draindown when main circulator pump stops running; pressure gauges installed across each pump so that system flow rates can be set and read periodically as a preventive maintenance check; collector angle of 30°.

28470 **(DOE/NASA/CR—161803) Solar heating system installed at Belz Investment Company, Memphis, TN. Final report.** (Belz Investment Co., Memphis, TN (USA)). Jun 1981. Contract FC01-78CS35210. 104p. NTIS, PC A05/MF A01. Order Number DE81027873.

Information is provided on the solar heating system installed at Belz Investment Company, Memphis, Tennessee. The system

used Solaron flat plate air collectors. Four buildings were included in the project. Collector area for each building covered 780 sq. ft., with storage capacity of 390 cubic feet per building. The Solaron air system has a special air handling unit to move air through the collectors and into and out of the rock storage, with connection to the air duct distribution system. The motor has Class B insulation on the windings to prevent deterioration as hot air passes over it. The heat of this motor is added to the heat delivered to the system. The solar system also includes four motorized special low-leakage dampers and two gravity fabric dampers. The system is designed to be automatically controlled by a Solaron-provided solid state controller with three thermistors: one located in the collectors, one in the rock box top plenum, one in the return air duct from the heated space. A three stage heating thermostat located in the conditioned space controls the operation.

28471 (DOE/SF/01978—T1) Solar energy utilization in composting toilets. Final report. Kroschel, M.L. (Farallones Inst., Occidental, CA (USA)). Feb 1981. Contract FG03-78SF01978. 48p. NTIS, PC A03/MF A01. Order Number DE81027811.

The goal of the study was to utilize solar energy in lieu of electricity to help alleviate the basic problems with compost toilets. Solar devices were first used to improve the performance of existing facilities and additional systems were designed from inception with solar heating and venting systems. Four independent studies were initiated and executed over the two years of the grant period: the design and construction of a solar pasteurization unit for treatment of 55-gal drum waste collection units; retrofit of an existing Clivus Multrum toilet for direct passive solar heat gain; design and construction of an owner-built flow-through compost toilet with a solar hot air heating system for hill side installation; and design and construction of an integrated bathroom facility that included a solar heated flow-through compost toilet with a solar chimney venting system. In general, the use of high temperature solar devices to enhance the biological process of composting within a privy vault was not successful. The compost toilets in the study demonstrated their vulnerability to shock over loading characteristic of public facilities and therefore demonstrated their unsuitability for such applications. However, their performance under more controlled use rates (at or below design maximum) merits further study.

28472 (DOE/SF/10606—T2) Solar-repowering industrial-retrofit system. (Foster Wheeler Development Corp., Livingston, NJ (USA)). 6 Dec 1979. Contract AC03-79SF10606. 32p. NTIS, PC A03/MF A01. Order Number DE81027233.

The specification defines the requirements and operating characteristics of a solar-powered process steam generating system that is proposed as a retrofit installation at the 92 dm^3/s (50,000 BPSD) Provident Energy Company (PEC) oil refinery in Mobile, Arizona. The referenced refinery is presently in a design engineering phase and is scheduled for an early 1984 start-up. The oil refinery will consume 4.14 MPa gage (600 lb/in^2g), 371°C (700°F) superheated steam at a yearly average rate of 21.4 kg/s (170,000 lb/h). The proposed solar retrofit will supply 20 percent of the refinery's yearly steam requirements and it will operate in parallel with three oil-fired boilers that will meet the balance of the plants steam requirements.

28473 (IS-M—352) Hodges residence: performance of a direct gain passive solar home in Iowa. Hodges, L. (Ames Lab., IA (USA)). 1980. Contract W-7405-ENG-82. 3p. (CONF-801016—25). NTIS, PC A02/MF A01. Order Number DE81025528.

From 5. national passive solar conference; Amherst, MA, USA (19 Oct 1980).

Results are presented for the performance of the Hodges Residence, a 2200-square-foot earth-sheltered direct gain passive solar home in Ames, Iowa, during the 1979-80 heating season, its first occupied season. No night insulation was used on its 500 square feet of double-pane glass. Total auxiliary heat required was 43 GJ (41 MBTU) gross and 26 GJ (25 MBTU) net, amounting, respectively, to 60 and 36 kJ/C^0-day-m^2 (2.9 and 1.8 BTU/F^0-day-ft^2). The heating season was unusually cloudy and included the cloudiest January in the 21 years of Ames insolation measurements. Results are also presented for the performance of the hollow-core floor which serves as the main storage mass and for the comfort range in the house.

28474 (LA—8885-MS) Design and analysis of direct gain solar heated buildings. Wray, W.O. (Los Alamos National Lab., NM (USA)). Jun 1981. Contract W-7405-ENG-36. 119p. NTIS, PC A06/MF A01. Order Number DE81026428.

Direct solar gains through south-facing windows can supply a significant portion of the space heating needs of properly designed residential and light commercial buildings. The performance of a direct gain building depends on the climate, the solar collection area, the heat loss characteristics of the building envelope, the amount of thermal storage mass within the living space, and many other design parameters or options. This relationship is complex and can be fathomed only by a systematic research program involving both experimentation and analysis. Such a program has been completed, and the results are herein cast in a form that is appropriate for quantitative thermal design.

28475 (LA-UR—81-1756) Program support for Active Buildings Division, System Development Branch, Office of Solar Applications for Buildings. Bankston, C.A. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 3p. (CONF-810912—7). NTIS, PC A02/MF A01. Order Number DE81025412.

From Active contractors' review meeting; Washington, DC, USA (Sep 1981).

Program support work performed by Los Alamos National Laboratory for the Department of Energy, Office of Solar Applications for Buildings, Division of Active Heating and Cooling is described. Background information and accomplishments are included.

28476 (LA-UR—81-2003) Correlation methods. Balcomb, J.D. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 6p. (CONF-810925—1). NTIS, PC A02/MF A01. Order Number DE81025379.

From 6. national passive conference; Portland, OR, USA (8 Sep 1981).

Correlation methods have been developed to provide a quick and relatively simple technique for estimating the performance of passive solar systems. The correlations are done with respect to data generated from simulation models. The techniques and accuracies are described. Both the Solar Load Ratio and Un-Utilizability methods are described. The advantages and limitations of correlation methods as design tools are discussed.

28477 (LA-UR—81-2102) Passive solar design handbook. Jones, R.W. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 4p. (CONF-810832—3). NTIS, PC A02/MF A01. Order Number DE81028694.

From DOE passive and hybrid solar energy program update; Washington, DC, USA (9 Aug 1981).

The Passive Solar Design Handbook, Volume Three updates Volume Two by presenting extensive new data on the optimum mix of conservation and solar direct gain, sunspaces, thermal storage walls, and solar radiation. The direct gain, thermal storage wall, and solar radiation data are greatly expanded relative to the Volume 2 coverage. The needed flexibility to analyze a variety of system designs is accommodated by the large number of reference designs to be encompassed - 94 in contrast to 6 in Volume two - and the large amount of sensitivity data for direct gain and sunspace systems - approximately 1100 separate curves.

28478 (LA-UR—81-2162) Los Alamos National Laboratory passive solar program. Neeper, D.A. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 12p. (CONF-810832—2). NTIS, PC A02/MF A01. Order Number DE81028778.

From DOE passive and hybrid solar energy program update; Washington, DC, USA (9 Aug 1981).

Progress in passive solar tasks performed at the Los Alamos National Laboratory for FY-81 is documented. A third volume of the Passive Solar Design Handbook is nearly complete. Twenty-

eight configurations of sunspaces were studied using the solar load ratio method of predicting performance; the configuration showing best performance is discussed. The minimum level of insolation needed to generate convective flow in the thermosiphon test rig is noted and measured. Information is also included on test room performance, off-peak auxiliary electric heating for a passive home, free convection experiment, monitored buildings, and technical support to the US Department of Energy.

28479 **(LA-UR—81-2185) State of the art in passive solar heating.** Balcomb, J.D. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 4p. (CONF-810832—1). NTIS, PC A02/MF A01. Order Number DE81028781.

From DOE passive and hybrid solar energy program update; Washington, DC, USA (9 Aug 1981).

The state of the art is outlined according to four major categories: passive solar practice, evaluation, design air, and products and materials. Needed future research activities and joint industry/government activities are listed. (MHR)

28480 **(LA-UR—81-2186) Heat storage duration.** Balcomb, J.D. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 6p. (CONF-810925—4). NTIS, PC A02/MF A01. Order Number DE81026635.

From 6. national passive conference; Portland, OR, USA (8 Sep 1981).

Both the amount and duration of heat storage in massive elements of a passive building are investigated. Data taken for one full winter in the Balcomb solar home are analyzed with the aid of subsystem simulation models. Heat storage duration is tallied into one-day intervals. Heat storage location is discussed and related to overall energy flows. The results are interpreted and conclusions drawn.

28481 **(LA-UR—81-2206) Attached sunspace design analysis.** Jones, R.W.; McFarland, R.D. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 6p. (CONF-810925—2). NTIS, PC A02/MF A01. Order Number DE81028738.

From 6. national passive conference; Portland, OR, USA (8 Sep 1981).

An introduction to new design analysis information for attached sunspaces is presented. The 28 sunspace reference designs are described. Note is taken of those designs (the semi-enclosed geometries) analyzed more recently than the previously published reports. The role of sensitivity studies is discussed, and some sample plots of sunspace performance sensitivity to key design parameters are presented. The monthly solar load ratio (SLR) correlations are reviewed with emphasis on the modified SLR used in the sunspace analysis. The application of the sunspace SLR correlations to monthly design analysis is outlined.

28482 **(LA-UR—81-2223) Dynamic measurement of heat loss coefficients through Trombe wall glazing systems.** Balcomb, J.D. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 6p. (CONF-810925—5). NTIS, PC A02/MF A01. Order Number DE81028736.

From 6. national passive conference; Portland, OR, USA (8 Sep 1981).

A Trombe wall presents a unique opportunity to measure the heat-loss coefficient through the glazing system because the wall itself can be used as a heat meter. Since the instantaneous heat flux through the outer wall surface can be determined, the heat loss coefficient at night can be calculated by dividing by the wall surface-to-ambient temperature difference. This technique has been used to determine heat-loss coefficients for Los Alamos test rooms during the winter of 1980-1981. Glazing systems studied include single and double glazing both with and without night insulation used in conjunction with a flat black paint, and both single and double glazing used in conjunction with a selective surface.

28483 **(LA-UR—81-2251) Long-term performance of the Hunn passive solar residence.** Hunn, B.D. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 6p. (CONF-810925—6). NTIS, PC A02/MF A01. Order Number DE81028735.

From 6. national passive conference; Portland, OR, USA (8 Sep 1981).

Detailed performance and annual energy consumption data are reported, as well as occupant observations and conclusions, for three heating seasons in the Hunn hybrid passive/active solar residence located in Los Alamos, New Mexico. The performance data were gathered by the Los Alamos National Laboratory and include hourly storage wall and interior temperature data for a midwinter period, an interior air-temperature histogram, and measured auxiliary energy consumption and solar heating fraction for each heating season. Also, energy and cost savings over the three-year period are estimated.

28484 **(LBL—12751) Controls for solar heating and cooling.** Warren, M.; Schiller, S.; Wahlig, M. (Lawrence Berkeley Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 4p. (CONF-810912—8). NTIS, PC A02/MF A01. Order Number DE81025209.

From Active contractors' review meeting; Washington, DC, USA (Sep 1981).

Several two day typical day experiments were run on the test facility using TMY weather data. Comparison of test facility results shows poor agreement with TRNSYS simulation in the parallel auxiliary mode, but good agreement in the series auxiliary mode. The test facility operates in a series boost mode. Solar heating system operation with two different operating strategies were run: direct collector to load heating and storage-coupled heating. No significant improvement in system performance was found for the direct heating strategy. Simulation analysis of the interaction of the solar heating system with the building load and thermostat was completed and presented. The analysis indicates that, using a conventional room thermostat, large temperature swings can be expected when the storage tank is charged to a high temperature.

28485 **(ORNL/TM—7802) Materials technology assessment of high-temperature solar receivers for fuels and chemicals production.** Tiegs, T.N. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 27p. NTIS, PC A03/MF A01. Order Number DE81027629.

Current interest in using solar thermal energy to produce fuels and chemicals has prompted an assessment of materials technology for five proposed designs of solar receivers. The principal process of interest is water splitting. Reaction schemes considered involve the high-temperature decomposition of sulfuric acid, and silicon carbide is the structural ceramic material usually considered most resistant to the conditions of this reaction. Hence we have assessed the fabricability of the designs from SiC for that reaction system, even though most designs envision use with air, helium, or nitrogen as a heat transfer medium. Honeycomb and hemispherical dome receivers have been fabricated from SiC. A receiver using planar coiled tubes has been fabricated from cordierite but not from SiC. Fabrication has not been demonstrated for helical coil and long tube designs. The last three of these should be fabricable with up to two years development. All lack the ultimate test: operational experience. The need for relable seals is common to all designs. Metallic gaskets are subject to corrosion, and ceramic and mechanical seals have not been demonstrated for the anticipated thermal cycling.

28486 **(P—500-81-017) Passive solar redesign for tract homes.** (California Energy Resources Conservation and Development Commission, Sacramento (USA)). Mar 1981. 333p. California Energy Resources Conservation and Development Commission, Sacramento. Order Number DE81903667.

The redesign of conventional tract homes to include cost-effective passive solar features can greatly increase their energy efficiency, while still remaining within the constraints of mass production and marketability. Ten tract home designs are modified to reduce their energy consumption through the use of simple, energy efficient, passive solar design considerations and construction techniques which are described in detail. The designs are modified by an iterative process of design, evaluation by computer simulation, and review. The predicted performance of all designs, original and modified, is summarized for six California climate zones in terms of annual heating and cooling costs. The modified designs are expected to use one-sixth to one-third as much energy for heating and

cooling as the original designs. At current energy prices, these savings amount to between $100, and $1200 per year, depending on the particular design and climate zone.

28487 **(SERI/TP—631-1254) Analysis of solar desiccant systems and concepts.** Barlow, R. (Solar Energy Research Inst., Golden, CO (USA)). May 1981. Contract AC02-77CH00178. 5p. (CONF-810912—6). NTIS, PC A02/MF A01. Order Number DE81023027.

From Active contractors' review meeting; Washington, DC, USA (Sep 1981).

A new approach to modeling desiccant systems has been developed. Computer programs for predicting the performance silica gel beds in single-blow situations and in cyclically operating desiccant cooling systems have been written (DESSIM). The single-blow model has been validated and shows excellent agreement with experimental data from SERI's desiccant test lab. Experimental data published by Koh are shown along with the corresponding prediction using DESSIM.

28488 **(SERI/TP—632-1253) Solar Desiccant Laboratory experiments.** Kutscher, C.F. (Solar Energy Research Inst., Golden, CO (USA)). May 1981. Contract AC02-77CH00178. 3p. (CONF-810912—5). NTIS, PC A02/MF A01. Order Number DE81023234.

From Active contractors' review meeting; Washington, DC, USA (Sep 1981).

The first validation attempts with experimental data on SERI's in-house absorption computer model are reported. The SERI Desiccant Test Loop design is shown. Some experimental runs were made to extend the validation over a wide range of inlet (temperature/humidity) conditions. (MHR)

28489 **(SERI/TR—721-1104) Active charge/passive discharge solar heating systems: thermal analysis and performance comparisons.** Swisher, J. (Solar Energy Research Inst., Golden, CO (USA)). Jun 1981. Contract AC02-77CH00178. 43p. NTIS, PC A03/MF A01. Order Number DE81027282.

This study analyzes the performance of active charge/passive discharge solar space heating systems. This type of system combines liquid-cooled solar collector panels with a massive integral storage component that passively heats the building interior by radiation and free convection. The TRNSYS simulation program is used to evaluate system performance and to provide input for the development of a simplified analysis method. This method, which provides monthly calculations of delivered solar energy, is based on Klein's Phi-bar procedure and data from hourly TRNSYS simulations. The method can be applied to systems using a floor slab, a structural wall, or a water tank as the storage component. Important design parameters include collector area and orientation, building heat loss, collector and heat-exchanger efficiencies, storage capacity, and storage-to-room coupling. Performance simulation results are used for comparisons with active and passive solar designs. Economic comparisons are based on these data and additional system features, such as cooling augmentation and integration of heating components with structural members.

28490 **(SOLAR/1069—81/50) Solar project description for Landura Corporation single family residence, Stayton, Oregon.** (Department of Housing and Urban Development, Washington, DC (USA); Boeing Co., Seattle, WA (USA)). 24 Jul 1981. Contract AB01-76CS31020. 57p. NTIS, PC A04/MF A01. Order Number DE81027253.

The Landura Corporation site is a single-family residence in Stayton, Oregon with approximately 1500 square feet of conditioned space. The solar energy system has an array of flat-plate collectors with a grass area of 357 square feet. The roof beneath the collector array is designed as a reflector surface and increases the effective collector area to 1072 square feet. Water is the transfer medium. Solar energy is stored above ground in two 1250-gallon tanks. Supply water is preheated in a heat exchanger coil in storage tank 1 and supplied, on demand, to a conventional 65-gallon DHW tank.

28491 **(TAC-STC—81-002) Solar thermal components: a bibliography with abstracts. Quarterly update April-June 1981.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). Jul 1981. 112p. Technology Application Center, Albuquerque, NM. Order Number DE81903775.

This annotated bibliography covers the following subjects: material properties, flat plate collectors, concentrating collectors, heat pumps, coolers and dehumidifiers, heat exchangers, solar ponds, distillation and desalination, agricultural process heat, industrial process heat, and irrigation pumps. (MHR)

28492 **Performance of cross-cooled desiccant dehumidifiers.** Mei, V.; Lavan, Z. (Oak Ridge Natl Lab, Tenn). *American Society of Mechanical Engineers, [Paper] ;* No. 80-WA/Sol-34, vp(1980).

A cross-cooled silica gel desiccant dehumidifer model was designed, built and tested. The performance of the unit was studied as a function of inlet process stream dew point, process stream and cooling stream flowrates and regeneration stream temperature and dewpoint. The tests were also simulated by a computer program and were compared to the experimental results. 12 refs.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 28414, 28424, 28425, 28448, 28491, 29043

28493 **(BNL—29680) Low-cost solar flat-plate-collector development.** Wilhelm, W.G. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 5p. (CONF-810912—4). NTIS, PC A02/MF A01. Order Number DE81025081.

From Active contractors' review meeting; Washington, DC, USA (Sep 1981).

Cost goals were developed for the collector which led to the rejection of conventional approaches and to the exploration of thin-film technology. A thin-film sola absorber suited for high-speed continous-roll manufacture at low cost was designed. The absorber comprises two sheets of aluminum-foil/polymeric-material laminate bonded together at intervals to form channels with water as the heat transfer fluid. Several flat-plate panels were fabricated and tested. (MHR)

28494 **(DOE/CS/31072—2) Study of aluminum corrosion in aluminum solar heat collectors using aqueous glycol solution for heat transfer. Final report, July 30, 1979-March 31, 1981.** Swette, L.L.; Cocks, F.H. (Giner, Inc., Waltham, MA (USA)). Jul 1981. Contract AC04-79CS31072. 97p. NTIS, PC A05/MF A01. Order Number DE81027582.

The present work was addressed both to the study of the effects of glycol aging at elevated temperatures over long periods of time and to investigation of zinc powder for cathodic protection of aluminum. Both uninhibited and inhibited ethylene and propylene glycols were aged at three different temperatures (100, 140, and 190°C) for 6000 hours. Samples were taken at 1000 hour intervals for pH measurment and chemical analysis. The glycols became more corrosive with increasing aging temperature and decreasing pH (< 8). The critical pitting potential (E/sub p/) of aluminum in chloride-ion containing aqueous glycol solutions was determined. Its dependence on temperature, chloride-ion concentration, and glycol content was investigated in detail. Aluminum is immune from pitting only when it is polarized (e.g. by contact to zinc) to below this pitting potential. E/sub p/ was found to become more negative with higher chloride-ion concentration, increasing temperature, and decreasing glycol content. Zinc powder was found to be effective in reducing aluminum pitting corrosion under simulated operating conditions that produced severe pitting in the absence of zinc. The consumption rate of zinc powder as a sacrificial anode, together with auto-corrosion, was found to be relatively high and is accompanied by a continuous low rate of hydrogen evolution.

28495 **(ETEC-TDR—81-3) TC-100 solar-collector review program. Final report summary.** Darnell, A.J.; Marlatt, W.P.; Roberts, J.K. (Energy Technology Engineering Center, Canoga Park, CA (USA)). Jun 1981. Contract AC03-76SF00700. 54p. NTIS, PC A04/MF A01. Order Number DE81028762.

Field and laboratory tests, materials investigation and tests, and thermal modeling work were conducted to determine the extent and effect of serpentine oxidation on thermal performance of the TC-100 solar collector. This work included measurements at six field installations to determine the extent of atmospheric fin oxidation on typical solar collectors at each site. Thermal efficiency performance tests were conducted at the Gilroy Foods solar installation. Field performance tests conducted separately on the two essentially identically constructed halves of this solar collector installation which had experienced significantly different periods of stagnation, i.e., subjected to solar insolation without coolant flow. Laboratory tests were also performed to determine performance of solar collectors subjected to varying amount of stagnation. Laboratory tests were conducted to determine the atmospheric oxidation of copper serpentines at temperatures up to 750°F. The oxidation of the copper fin was found to be dependent upon fin stagnation temperature, number of stagnation cycles and humidity. At temperatures below 300°F atmospheric oxidation of the fin was negligible, at 750°F it increased significantly. Low system thermal performance of the TC-100 collector cannot be attributed to fin oxidation alone. Worst case of oxidation reduced thermal performance of the collector by 2 to 3 percentage points; complete removal of the collector fins gave a reduction of 5 percentage points.

28496 **(LA—8897-SR) Status report on solar-absorber-paint coatings.** Moore, S.W. (Los Alamos Scientific Lab., NM (USA)). Jul 1981. Contract W-7405-ENG-36. 22p. NTIS, PC A02/MF A01. Order Number DE81026445.

The Department of Energy has funded a number of programs that have investigated the stability and durability of solar absorber paint coatings. Some of the findings resulting from these programs are presented. Although the basic thrust of the programs has been to investigate changes in optical properties, other physical failures are described.

28497 **(LA-UR—81-1757) Collector research and development.** Neeper, D.A. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 4p. (CONF-810912—9). NTIS, PC A02/MF A01. Order Number DE81025411.

From Active contractors' review meeting; Washington, DC, USA (Sep 1981).

Current solar collector research of the Los Alamos National Laboratory is described. The document is divided into three sections dealing with the three aspects of the program: reliability and maintainability, optical materials, and evacuated tube collector testing.

28498 **(LA-UR—81-2252) Test results and analysis of a convective loop solar air collector.** Biehl, F.A. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 6p. (CONF-810925—3). NTIS, PC A02/MF A01. Order Number DE81028151.

From 6. national passive conference; Portland, OR, USA (8 Sep 1981).

The test results and analysis methods employed in studying the general design parameters of an air convective loop solar collector are presented. The purpose of the test program is to validate a simulation model that can also be extended to other collector arrangements and to a variety of weather patterns. Details of the collector configurations, typical test results, simulation model, and comparison between test and analysis results are discussed. The good agreement between test and analysis suggests that the analytical model can be employed for sensitivity studies. Results (not presented here) show that the collector efficiency, mass flow rate, and air temperature gain are sensitive to the air passage depth behind the absorber plate. A range of desirable collector lengths, based upon efficiency considerations, is determined employing the analytical model.

28499 **(MLM—2830(OP)) Evaluation of solar pond performance.** Wittenberg, L.J. (Monsanto Research Corp., Miamisburg, OH (USA)). 1981. Contract AC04-76DP00053. 3p. (CONF-810912—2). NTIS, PC A02/MF A01.

From Active contractors' review meeting; Washington, DC, USA (Sep 1981).

During 1978 the City of Miamisburg constructed a large, salt-gradient solar pond as part of its community park development project. The thermal energy stored in the pond is being used to heat an outdoor swimming pool in the summer and an adjacent recreational building during part of the winter. This solar pond, which occupies an area of 2020 m^2 (22,000 ft^2), was designed from experience obtained at smaller research ponds. This project is directed toward data collection and evaluation of the thermal performance and operational characteristics of the largest, operational, salt-gradient solar pond in the United States; to gain firsthand experience regarding the maintenance, adjustments and repairs required of a large, operational solar pond facility; and to provide technical consulation regarding the operation and the optimization of the pond performance.

28500 **(MRC-DA—944) Low-cost mirror concentrator based on inflated, double-walled, metallized, tubular films.** Schwendeman, J.L.; Ball, G.L. III.; Leffingwell, J.W.; McClung, C.E. (Monsanto Research Corp., Dayton, OH (USA). Dayton Lab.). Jul 1981. Contract AC04-78AL04227. 121p. (ALO—4227-6). NTIS, PC A06/MF A01. Order Number DE81027813.

A potentially low-cost, inflatable plastic solar mirror concentrator based on segments of a cylinder joined along the length of the collector on a plane passing through the axis of the absorber tube was designed and built. This design results in a savings of approximately 40% in the amount of window and mirror material and in a savings of about 20% of the land area occupied by a single collector when compared to a fully cylindrical one. The type of construction permits the assemblying of the mirror/window envelope to the collector without disturbing the collector frame, absorber tube, or the associated plumbing. Aluminum foil-plastic laminates were used as an alternative to aluminized polyester films, because of their potential low-cost and durability. Specially uv stabilized and polyester scrim reinforced flexible PVC film was developed for use as the outer cover material.

28501 **(NP—1903563) Demonstration of the solar gel pond. Final Report, February 1, 1980-January 31, 1981.** Wilkins, E.S. (New Mexico Univ., Albuquerque (USA)). Jul 1981. 93p. (EMD—2-68-2130). New Mexico Energy and Minerals Department, Santa Fe. Order Number DE81903563.

The primary objective of the research was to develop viscous polymeric gels to act as a thermal insulator and to produce high energy collection and storage efficiencies. These polymer gels were tested in a small-scale solar pond. The highest bottom temperature was achieved with the bottom layer filled with a salt solution and covered with a top layer of 16 cm polymer gel. By covering the gel layer with a thin layer of water, dirt and debris falling onto the pond can be skimmed, and evaporation can be retarded. The highest bottom temperature and satisfactory efficiency (72%) were obtained with the addition of a gel layer 16 cm thick as an insulation on the top of the saline.

28502 **AES second coatings for solar collectors symposium.** Contract AC02-77CH00178. Winter Park, FL; American Electroplaters' Society, Inc. (1979). 197p. (CONF-791021—).

From 2. American Electroplaters Society symposium on coatings for solar collectors; St Louis, MO, USA (16 Oct 1979).

Separate abstracts were prepared for 11 papers in these proceedings. Two other papers have appeared in the Energy Data Base previously. Also included in the proceedings are 4 abstracts for which the papers were not available for publication. (LEW)

1420 Heat Storage

REFER ALSO TO CITATION(S) 28501

28503 (DOE/CS/30139—T1) Studies of heat transfer and water migration in soils. Final report. Walker, W.R.; Sabey, J.D.; Hampton, D.R. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Apr 1981. Contract AC02-79CS30139. 140p. NTIS, PC A07/MF A01. Order Number DE81023951.

Simultaneous transfer of heat and water through partially saturated soils was described by both theoretical analyses and laboratory measurements. The theoretical efforts produced computer coded simulation models of coupled water and heat flux in soils and thermal conductivity as a function of water content, bulk density, mineralogical composition, and temperature. The laboratory data were used to calibrate and verify the simulation models. A prototype thermal storage reservoir using in-situ soil materials was constructed and evaluated. The feasibility of trans-seasonal heat storage was demonstrated. Efficient use of in-situ soil materials as a heat storage system requires that wet soil be used to store the heat while surrounding soils be as dry as possible. To accomplish this separation, various impermeable barriers were studied.

28504 (DOE/CS/34698—T1) Salt-hydrate thermal-energy-storage system for space heating and air conditioning. Final report, December 1, 1977-June 30, 1980. MacCracken, C.D.; Armstrong, J.M.; MacCracken, M.M.; Silvetti, B.M. (Calmac Mfg. Corp., Englewood, NJ (USA)). 1980. Contract AC02-78CS34698. 86p. NTIS, PC A05/MF A01. Order Number DE81023402.

Latent heat storage equipment is being developed using 3 different salts. They are sodium sulfate pentahydrate which melts at 46°C, magnesium chloride hexahydrate which melts at 115°C, and a eutectic combination of seven different materials which melts at 7°C. Development work is reported on stirring pumps, tank and tubing materials, and field filling of the salts into their tanks. Performance testing is also reported. Good performance is reported for the tank/heat exchangers with all three salts. Both the 115°C and 46°C salts are almost equivalent in volume storage to water/ice. The 7°C salt, however, begins at about 56% of the BTU's per cubic foot of water/ice and declines due to separation to 40% after repeated cycling. (LEW)

15 GEOTHERMAL ENERGY

1501 Resource Status And Assessment

28505 (CONF-810812—28) Identification of geopressured occurrences outside of the Gulf Coast. Strongin, O. (Science Applications, Inc., McLean, VA (USA)). 1981. Contract AC08-80NV10133. 6p. NTIS, PC A02/MF A01. Order Number DE81025511.

From IECEC conference; Atlanta, GA, USA (9 Aug 1981).

Methane dissolved in saline formation waters under abnormally high pressure (geopressure) is one of several unconventional gas sources that is under intensive investigation by the Department of Energy. The most well-known and studied region of geopressures in the US is the Gulf Coast geosyncline. Recent studies, however, indicate that this phenomenon is displayed in many other sedimentary basins encompassing lithologies and sedimentary environments unlike those of the Gulf Coast. These include various Rocky Mountain and Mid-Continent basins, onshore and offshore Californian, Alaskan and Pacific Coast basins, and other isolated occurrences. Of this group, two prime target areas, based on the indicated methane content of geopressured formation waters, would include the Cambrian sands of the Rome trough in West Virginia and selected Miocene sediments along the west side of the San Joaquin Valley in California.

28506 (DOE/ET/27196—T3) Imperial County geothermal development. Quarterly report, April 1, 1980-June 30, 1981. (Imperial, County of, El Centro, CA (USA). Dept. of Public Works). 1981. Contract FC03-79ET27196. 32p. NTIS, PC A03/MF A01. Order Number DE81027116.

Three areas are reported: Geothermal Administration, Geothermal Planning; and other Geothermal Activities. Geothermal Administration addresses the status of the Imperial Valley Environmental Project (IVEP) transfer, update of the Geothermal Resource Center, and findings of Geothermal field inspections. Field inspections will cover the four new wells drilled by Magma at the Salton Sea in preparation for 28 MW power plant, the progress at Sperry at East Mesa, and the two on-line power plants in East Mesa and North Brawley. Evaluation of cooperative efforts will cover the Geothermal Subsidence Detection Network Resurvey, Master EIR for the Salton Sea and the Annual Imperial County Geothermal meeting. The status of Geothermal development throughout the County will cover existing proposed facilities. The summary of the Geothermal meeting (Appendix A) will also provide the status of several projects. Geothermal Planning addresses the EIR Notice of Exemption from CEQA, progress on the Master EIR for the Salton Sea, and the EIR for Phillips Petroleum for 6 exploratory wells in the Truckhaven area. Other Geothermal Activity addresses the Department of Energy Region IX meeting hosted by Imperial County, the Annual Imperial County Geothermal meeting, Class II-1 geothermal hazardous waste disposal siting study, and Imperial County Geothermal Direct Heat Study.

28507 (DOE/NV/10133—2) Identification of geopressured occurrences outside of the Gulf Coast. Strongin, O. (Science Applications, Inc., McLean, VA (USA)). 5 Mar 1981. Contract AC08-80NV10133. 114p. NTIS, PC A06/MF A01. Order Number DE81027583.

The work focused on the occurrences of geopressures in Appalachia and selected California basins. In the former region, where geopressures have been observed, the pressure gradients for the most part were only slightly above normal as in the case of the Oriskany formation of Devonian age; this unit was also characterized by extremely high salinity. The one notable exception was in the Rome trough of West Virginia where Cambrian beds at depths below 10,000 feet display very high geopressures, approaching the lithostatic gradient, and the waters are only moderately saline. Though the geothermal gradient throughout Appalachian is relatively low, even in the Rome trough, the pressure, temperature and salinity values in this area indicate that the methane content of the Cambrian formation waters is in the range of 30 to 35 SCF/barrel. The two California areas researched included the contiguous Sacramento and San Joaquin Valleys. In the first, geopressures have been principally encountered in the Forbes formation of Cretaceous age, often at very shallow depths. Further waters are invariably characterized by very low salinity, far below the salinity of normal sea water, while the geothermal gradient in apparently higher in geopressured than in normally pressured zones. In the San Joaquin Valley, geopressures are particularly noteworthy in at least two formations of Miocene age at depths generally greater than those of the Forbes. The formation waters are likewise low in salinity; however, the geothemal gradient, especially in the geopressured zones on the west side of the valley, can be extremely high, up to twice as much as the normal temperature gradient. In view of these conditions, it is estimated that in the western San Joaquin Valley the methane content of geopressured formation waters will range from 30 to 40 SCF/barrel while in the Sacramento Valley, the methane content is estimated to be 20 to 25 SCF/barrel.

28508 (LA—8812-MAP) Age and location of volcanic centers ≦ 3.0 Myr old in Arizona, New Mexico and the Trans-Pecos Area of West Texas. Aldrich, M.J.; Laughlin, A.W. (Los Alamos National Lab., NM (USA)). Apr 1981. Contract W-7405-ENG-36. 24p. NTIS, PC A02/MF A01. Order Number DE81028543.

This map is one of a series of maps designed for hot dry rock geothermal assessment in Arizona, New Mexico, and the Trans-Pecos area of west Texas. The 3.0 m.y. cutoff age was selected because original heat has probably largely dissipated in older rocks. The location of volcanic centers is more important to geothermal resource assessment than the location of their associated volcanic rocks; however, ages have been determined for numerous flows far from their source. Therefore, the distribution of all volcanic rocks ≦ 3.0 m.y. old, for which there is at least one determined age, are shown. Location of the volcanic vents and rocks were taken from Luedke and Smith (1978).

1502 Geology And Hydrology Of Geothermal Systems

REFER ALSO TO CITATION(S) 28507

28509 (DOE/ET/27111—T1) Shale mineralogy and burial diagenesis of Frio and Vicksburg Formations in two geopressured wells, McAllen Ranch area, Hidalgo County, Texas. Freed, R.L. (Trinity Univ., San Antonio, TX (USA)). 1980. Contract AC08-79ET27111. 17p. NTIS, PC A02/MF A01. Order Number DE81025180.

Thirty-six shale samples ranging in depth from 1454 ft to 13,430 ft from Shell Oil Company No. 1 Dixie Mortage Loan well and 33 shale samples ranging in depth from 2183 ft to 13,632 ft from Shell Oil/Delhi-Taylor Oil Corporation No. 3 A.A. McAllen well were examined by x-ray techniques to determine the mineralogical parameters of the geopressured zone in the Vicksburg Fairway. Both wells have the same weight-percent trends with depth for the mineralogy: quartz, calcite, total clay, and potassium feldspar are constant; plagioclase feldspar gradually increases; kaolinite increases; discrete illite decreases; total mixed-layer illite-smectite (I/S) decreases; illite in mixed layer I/S increases; and smectite in mixed-layer I/S decreases. Chlorite is found only in the geopressured zone of each well. The Boles and Franks model is compatible with a steady supply of original mixed-layer I/S during the depositional history of the McAllen Ranch area. The constant content with depth of calcite, quartz, and potassium feldspar indicates that limited material, if any, is supplied by the shales to surrounding sands. The ions generated by changes within the clay minerals are involved in further clay mineral reactions as outlined above. In addition, magnesium and iron are involved in forming chlorite within the shales.

28510 (LAL—81-18) Rio Grande rift, a window into the earth. Helmick, C. (Los Alamos National Lab., NM (USA)). May 1981. Contract W-7405-ENG-36. 4p. NTIS, PC A02/MF A01. Order Number DE81026798.

The rift structure, volcanism, and earthquake activity of the Rio Grande Rift are reviewed. (MHR)

1503 Geothermal Exploration And Exploration Technology

REFER ALSO TO CITATION(S) 28510

28511 (DOE/ET/27163—8) Baca geothermal demonstration project. Equation-of-state for water-carbon dioxide mixtures: implications for Baca reservoir. Pritchett, J.W.; Rice, M.H.; Riney, T.D. (Systems, Science and Software, La Jolla, CA (USA)). Feb 1981. Contract FC03-78ET27163. 57p. NTIS, PC A04/MF A01. Order Number DE81026881.

An equation-of-state package for water-carbon dioxide mixtures has been constructed from available thermodynamic data that covers the range of interest to the Baca reservoir system. The package has been used to examine the thermodynamic state of the Baca reservoir fluid for conditions of temperature, pressure and CO_2 content believed to bracket conditions existing at the production depth of the wells in the Redondo Creek area. It is shown that the reservoir fluid may be either all-liquid or two-phase at various well locations and depths, depending on the CO_2 content. It is also shown that the CO_2 content at reservoir conditions cannot be reliably inferred from pressure/temperature measurements made on flowing wells. The equation-of-state package has been incorporated into a general purpose geothermal reservoir simulator and a series of calculations made which show that the CO_2 content of the produced fluid may be less than or greater than that of the reservoir fluid. The characteristics of the produced fluid are sensitive to the CO_2 content in the reservoir.

28512 (DOE/ID/12183—T2) Geochemical engineering problem identification and program description. Final report. Crane, C.H.; Kenkeremath, D.C. (Engineering and Economics Research, Inc., Falls Church, VA (USA)). May 1981. Contract AC07-80ID12183. 77p. NTIS, PC A05/MF A01. Order Number DE81027585.

The Geochemical Engineering Program has as its goal the improvement of geochemical fluid management techniques. This document presents the strategy and status of the Geochemical Engineering Program. The magnitude and scope of geochemical-related problems constraining geothermal industry productivity are described. The goals and objectives of the DGE Geochemical Engineering Program are defined. The rationale and strategy of the program are described. The structure, priorities, funding, and management of specific elements within the program are delineated, and the status of the overall program is presented.

1504 Legal And Institutional Aspects

28513 (DOE/ET/27194—T2) Geothermal policy development program analysis of county general plans, specific plans and zoning. (GRIPS Commission, Santa Rosa, CA (USA)). Jul 1981. Contract FC03-79ET27194. 45p. NTIS, PC A03/MF A01. Order Number DE81026879.

This study evaluates the local geothermal permitting practices of the four Geysers-Calistoga KGRA counties (i.e. Lake, Mendocino, Napa and Sonoma), in California, and the ways in which these processes could be expedited. The detailed analysis of local permitting processes undertaken in the course of this project revealed great variation in procedural approach, types of conditions imposed, phrasing of conditions and length of time it takes to process use permits; and these variations are described in the report. The analysis also revealed a number of interesting techniques employed by one or the other of the counties, or by Imperial County, to improve the process. These techniques are also described. Finally, four alternative approaches to expediting the local geothermal permitting process are identified.

28514 (DOE/ET/27194—T3) Geothermal policy development program. Geothermal issues that cross county lines. (GRIPS Commission, Santa Rosa, CA (USA)). 1981. Contract FC03-79ET27194. 60p. NTIS, PC A04/MF A01. Order Number DE81026877.

The principal issues related to geothermal resources for the production of electricity, which cross county lines, as well as issues which may not cross county lines but which are of common concern to the four counties in The Geysers-Calistoga KGRA are identified and described briefly. As this compilation makes clear, the generation of electricity at The Geysers does not occur in a trouble-free environment - rather, it occurs under difficult circumstances componded by jurisdictional fragmentation. These factors are recognized by grouping the issues according to whether they are Environmental, Administrative, or Planning in nature.

28515 (DOE/ET/27194—T4) Geothermal policy development program: expediting the local geothermal permitting process. (GRIPS Commission, Santa Rosa, CA (USA)). Jul 1981. Contract FC03-79ET27194. 216p. NTIS, PC A10/MF A01. Order Number DE81026878.

For a number of years, concerns have been raised about the length of time and the complexity involved in obtaining required permits in order to develop the geothermal resource at the Geysers. Perhaps the most important factor is jurisdiction. At the Geysers, all three levels of government - local, state, and federal - exercise significant authority over various aspects of geothermal development. In addition, several agencies within each governmental level play an active role in the permitting process. The present study is concerned primarily with the local permitting process, and the ways in which this process could be expedited. This report begins by looking at the local role in the overall permitting process, and then reviews the findings and conclusions that have been reached in other studies of the problem. This is followed by a case study evaluation of recent permitting experience in the four Geysers-Calistoga KGRA counties, and the report concludes by outlining several approaches to expediting the local permitting process.

28516 **(DOE/ET/27241—T1) Study and analysis of selected legal, institutional, and public-policy problems effecting hydrothermal geothermal commercialization in the five Pacific Rim States. Final technical report.** (JM Energy Consultants, Inc., Los Angeles, CA (USA)). 9 Jul 1981. Contract AC03-79ET27241. 9p. NTIS, PC A02/MF A01. Order Number DE81027173.

Summaries and updates of sixteen technical reports issued on this project are included. They cover: in depth analyses of the Federal land management-related problems present at major target prospect KGRA's throughout the Pacific Rim States; financial incentives; transmission line access; substantive environmental requirements in air, water, and solid wastes; water law; and the geothermal-impacting activities of the legislative and regulatory agencies of the State of California. (MHR)

28517 **(DOE/SF/01795—T7) State government workshop on barriers and incentives of geothermal-energy resources. Quarterly report, May 1, 1979-July 31, 1979.** (National Conference of State Legislatures, Denver, CO (USA)). Aug 1979. Contract FG03-78SF01795. 102p. NTIS, PC A06/MF A01.

Efforts to initiate and follow up geothermal study activities in selected project states are described and personnel appointments are listed. Plans are presented for future work. (LEW)

1505 Economic And Financial Aspects

28518 **Optimal energy extraction from a hot water geothermal reservoir.** Golabi, K.; Scherer, C.R.; Tsang, C.F.; Mozumder, S. (Woodward-Clyde Consult, San Francisco, Calif). *Water Resources Research ;* **17**: No. 1, 1-10(Feb 1981).

An analytical decision model is presented for determining optimal energy extraction rates from hot water geothermal reservoirs when cooled brine is reinjected into the hot water aquifer. This applied economic management model computes the optimal fluid pumping rate and reinjection temperature and the project (reservoir) life consistent with maximum present worth of the net revenues from sales of energy for space heating. The real value of product energy is assumed to increase with time, as is the cost of energy used in pumping the aquifer. The economic model is implemented by using a hydrothermal model that relates hydraulic pumping rate to the quality (temperature) of remaining heat energy in the aquifer. 20 refs.

1506 Environmental Aspects And Waste Disposal

REFER ALSO TO CITATION(S) 28506, 28522

28519 **(DOE/ET/27152—T1) Draft final report. Phase I.** (California Energy Resources Conservation and Development Commission, Sacramento (USA)). 30 Jan 1979. Contract FG03-78ET27152. 34p. NTIS, PC A03/MF A01. Order Number DE81021008.

The current status and coordination of efforts related to the eighteen environmental studies identified for the Geysers-Calistoga KGRA are reported. (MHR)

28520 **(EGG—2113) INEL geothermal environmental program. 1980 annual report.** Cahn, L.S.; Thurow, T.L.; Martinez, J.A. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1981. Contract AC07-76ID01570. 73p. NTIS, PC A04/MF A01. Order Number DE81025671.

An overview of continuing environmental research and monitoring programs conducted at the Raft River Geothermal Site is provided. The monitoring programs are designed to collect data on the physical, biological and human environments of the development area. Primary research during 1980 emphasized completing baseline studies on terrestrial fauna, establishing an air quality monitoring network, investigating potential sources of fluoride in the Raft River Valley, and studying water level changes in the shallow monitor wells in response to development of the geothermal resource.

28521 **(LBL—11539) Geopressured geothermal resource of the Texas and Louisiana Gulf Coast: a technology characterization and environmental assessment.** Usibelli, A.; Deibler, P.; Sathaye, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1980. Contract W-7405-ENG-48. 259p. NTIS, PC A12/MF A01. Order Number DE81028905.

Two aspects of the Texas and Louisiana Gulf Coast geopressured geothermal resource: (1) the technological requirements for well drilling, completion, and energy conversion, and, (2) the environmental impacts of resource exploitation are examined. The information comes from the literature on geopressured geothermal research and from interviews and discussions with experts. The technology characterization section emphasizes those areas in which uncertainty exists and in which further research and development is needed. The environmental assessment section discusses all anticipated environmental impacts and focuses on the two largest potential problems: (a) subsidence and (b) brine disposal.

1507 By-products

28522 **(UCID—19090) High-pressure solvent extraction of methane from geopressured brines: technical evaluation and cost analysis.** Quong, R.; Otsuki, H.H.; Locke, F.E. (Lawrence Livermore National Lab., CA (USA)). Jul 1981. Contract W-7405-ENG-48. 29p. NTIS, PC A03/MF A01. Order Number DE81027837.

Solvent extraction is proposed as a means of recovering dissolved methane from geopressured-geothermal brines at high pressures. The assessment shows that additional investment in a high pressure solvent extraction plant preceding direct injection disposal of brines into isolated aquifers can be profitable. The technical and economic issues are discussed, and compared with other injection methods such as complete depressurization for methane recovery followed by conventional mechanical pumping. The contributions of hydraulic (pressure) energy recovery and geothermal power production are also assessed. For deep injection into the producing formation, it is concluded that methane extraction processes are not applicable, insofar as maintenance of high surface pressures provides no clear-cut energy benefits. As a first step in the evaluation of solvent extraction, the solubility of a promising solvent candidate, n-hexadecane, was measured in 15 wt % NaCl solutions at temperatures up to 150°C. The solubility of a potential low cost solvent, No. 2 Diesel fuel, was also measured.

1508 Geothermal Power Plants

REFER ALSO TO CITATION(S) 28515, 28531

28523 **(CONF-810679—1) Geothermal heat transfer, district heating and cooling.** Michel, J.W.;. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 4p. NTIS, PC A02/MF A01. Order Number DE81023195.

From Heat transfer and heat exchangers workshop; Vail, CO, USA (18 Jun 1981).

The types of geothermal systems are defined. Heat rejection and scaling problems in power cycles are mentioned and other heat transfer areas of inerest in geothermal applications are indicated. (MHR)

28524 **(DOE/ET/27163—9) Baca geothermal demonstration project. Quarterly technical progress report, October 1-December 31, 1980.** (WESTEC Services, Inc., Albuquerque, NM (USA)). Mar 1981. Contract FC03-78ET27163. 22p. NTIS, PC A02/MF A01. Order Number DE81026884.

Work completed on the Baca 50 Megawatt (MWe) Geothermal Demonstration Power Plant Project, Baca Location No. 1, New Mexico is reported. Topics covered in this quarterly report include progress made in the well and steam production systems, the power plant and transmission systems, and in the project data management program.

28525 **(DOE/ET/28320—48) Analysis of thermal/mechanical energy-conversion concepts. Final report.** DiPippo, R. (Brown Univ., Providence, RI (USA)). Jun 1981. Contract AS02-76ET28320. 15p. NTIS, PC A02/MF A01. Order Number DE81027854.

Project activities and publications are listed. (MHR)

28526 **(DOE/ET/28443—T8) Geothermal Thermal Loop Facility. Quarterly project report, October-December 31, 1975.** (San Diego Gas and Electric Co., CA (USA)). 19 Jan 1976. Contract AC03-76ET28443. 13p. NTIS, PC A02/MF A01. Order Number DE81024239.

The following are covered: construction status, operation activities, and project cash flow. (MHR)

28527 **(DOE/RA/50239—1) Heber Geothermal Binary Demonstration Project. Quarterly technical progress report, September 15, 1980-March 31, 1981.** Hanenburg, W.H.; Lacy, R.G.; Van De Mark, G.D. (San Diego Gas and Electric Co., CA (USA)). Jun 1981. Contract FC03-80RA50239. 32p. NTIS, PC A03/MF A01. Order Number DE81027446.

Work completed on the nominal 65 Megawatt (Mwe gross) Heber Geothermal Binary Demonstration Project, located at Heber, California, during the period of September 15, 1980, through March 31, 1981 is documented. Topics covered in this quarterly report include progress made in the areas of Wells and Fluids Production and Injection Systems, Power Plant Design and Construction, Power Plant Demonstration, and Data Acquisition and Dissemination.

28528 **(LBL—12850) Supercritical heat exchanger field test (SHEFT), I. Field performance data on shell-and-tube heat exchangers in geothermal service.** Silvester, L.F.; Beaulaurier, L.O.; Mirk, K.F.; Fulton, R.L. (Lawrence Berkeley Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 16p. NTIS, PC A02/MF A01. Order Number DE81027632.

Field performance data on shell-and-tube heat exchangers in geothermal service are presented. The test data were taken for geothermal brine on the tube side and hydrocarbon on the shell side in counterflow for six primary heat exchangers, and for hydrocarbon on the shell side and cooling water on the tube side for the condenser. Test data were for heating isobutane, 1 90/10 isobutane/isopentane mixture, and a 80/20 isobutane/isopentane mixture at supercritical conditions in the vicinity of their critical pressure and temperature, and for condensing the same fluids. The test data were used in a preliminary data analysis to determine the reported heat exchanger performance parameters.

1509 Geothermal Engineering

REFER ALSO TO CITATION(S) 28512, 28521, 28526

28529 **(CONF-801233—10) Is geothermal simulation a catastrophe.** Nguyen, V.V.; Pinder, G.F. (Princeton Univ., NJ (USA)). 1980. Contract AC03-80SF11489. 5p. NTIS, PC A02/MF A01. Order Number DE81026750.

From 6. annual workshop on geothermal reservoir engineering; Stanford, CA, USA (16 Dec 1980).

All numerical simulators of geothermal reservoirs depend upon an accurate representation of the thermodynamics of steam-water systems. These relationships are required to render tractable the system of balance equations derived from the physics of flow through porous media. While it is generally recognized that the steam-water system (i.e., two phase) is not in thermodynamic equilibrium, equilibrium thermodynamics are employed in its description. An alternative view based on non-equilibrium thermodynamics is presented. The underpinnings of this approach are found in a branch of topology generally referred to as catastrophe theory.

28530 **(DOE/ET/27081—4) Testing geopressured geothermal reservoirs in existing wells: Pauline Kraft Well No. 1, Nueces County, Texas. Final report.** (Eaton Operating Co., Inc., Houston, TX (USA)). 1981. Contract AC08-80ET27081. 147p. NTIS, PC A07/MF A01. Order Number DE81027277.

The Pauline Kraft Well No. 1 was originally drilled to a depth of 13,001 feet and abandoned as a dry hole. The well was reentered in an effort to obtain a source of GEO^2 energy for a proposed gasohol manufacturing plant. The well was tested through a 5-inch by 2-3/8 inch annulus. The geological section tested was the Frio-Anderson sand of Mid-Oligocene age. The interval tested was from 12,750 to 12,860 feet. A saltwater disposal well was drilled on the site and completed in a Micocene sand section. The disposal interval was perforated from 4710 to 4770 feet and from 4500 to 4542 feet. The test well failed to produce water at substantial rates. Initial production was 34 BWPD. A large acid stimulation treatment increased productivity to 132 BWPD, which was still far from an acceptable rate. During the acid treatment, a failure of the 5-inch production casing occurred. The poor production rates are attributed to a reservoir with very low permeability and possible formation damage. The casing failure is related to increased tensile strain resulting from cooling of the casing by acid and from the high surface injection pressure. The location of the casing failure is now known at this time, but it is not at the surface. Failure as a result of a defect in a crossover joint at 723 feet is suspected.

28531 **(DOE/ET/28443—T7) Geothermal Loop Facility Project. Quarterly report, January 1-March 31, 1976.** (San Diego Gas and Electric Co., CA (USA)). 23 Apr 1976. Contract AC03-76ET28443. 24p. NTIS, PC A02/MF A01. Order Number DE81024231.

The following topics are covered: construction status, system operation, other start-up activities, and task force modifications. (MHR)

28532 **(LBL—10910) WELBORE user's manual.** Miller, C.W. (Lawrence Berkeley Lab., CA (USA)). Jan 1980. Contract W-7405-ENG-48. 50p. NTIS, PC A03/MF A01. Order Number DE81028549.

WELBORE is a computer code for simulating transient, one-dimensional two-phase or single-phase non-isothermal fluid flow in a wellbore. The program uses a partially implicit method to solve the finite difference approximation of the Navier-Stokes equations of mass, momentum, and energy conservation. Terms that would impose a severe time restriction, such as the compressibility terms are evaluated implicitly while other terms are expressed in an explicit manner. The convection effects are represented with a conserving upwind finite difference. Both the slip between the phases (when the flow is two-phase) and the frictional losses are given as empirical correlations. The primary thermodynamic variables used in solving the equations are the pressure and specific energy. An equation of state subroutine provides the density, quality, and temperature. The heat loss out of the wellbore is calculated by solving a radial diffusion equation for the temperature changes outside the bore. The calculation is done at each node point in the wellbore. Also the code has been coupled with a single phase radial flow reservoir model.

1510 Direct Energy Utilization

REFER ALSO TO CITATION(S) 28523

28533 **(DOE/ET/28436—T1) Multiflash feed-and-bleed coupling for the evaporation and crystallization industry. Technical report, September 29-December 31, 1976.** Basuino, D.J.; Doyle, P.T. (Bechtel National, Inc., San Francisco, CA (USA)). 1976. Contract AC03-76ET28436. 71p. NTIS, PC A04/MF A01.

A program is described to determine the technical and economic feasibility of using geothermal brine in place of steam from conventional sources for industrial multieffect evaporation and crystallization. A key aspect of the study is that the multiflash feed-and-bleed concept will be incorporated in the evaporation and crystallization processes to use the geothermal energy most effectively. The following are included: a listing of industries that show the most promise as potential geothermal brine users; a summary of available process information for these industries; a description of a multieffect heat and material balance-optimization computer program; geothermal brine source location data; and initial information about geothermal well and pipeline economics. Preliminary conclusions are discussed and work to be performed is outlined.

1520 Geothermal Data And Theory

REFER ALSO TO CITATION(S) 28294, 28511

16 TIDAL POWER

1607 Tidal Power Plants

28534 (SERI/TP—634-1195) Ocean energy-waves, currents, and tides. Miles, J.; Shelpuk, B. (Solar Energy Research Inst., Golden, CO (USA)). May 1981. Contract AC02-77CH00178. 11p. (CONF-810808—8). NTIS, PC A02/MF A01. Order Number DE81025708.

From Energy in the man-built environment: the next decade specialty conference; Vail, CO, USA (3 Aug 1981).

An overview is presented on the mechanical forms of ocean energy; i.e., waves, currents, and tides. Following an introductory section on wave mechanics, each of the three forms of ocean energy is considered under the headings of the resource, device types for energy extraction, and prognosis for practical implementation.

1608 Wave Energy Converters

REFER ALSO TO CITATION(S) 28534

17 WIND ENERGY

28535 (PNL—3214) Proceedings of the conference and workshop on wind energy characteristics and wind energy siting, 1979. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1979. 471p. (CONF-790665—). American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

This conference contains 38 papers, 33 of which are abstracted separately. The subject matter is concerned with wind energy in terms of characteristics for operations, resource assessment and siting methodologies. The main engineering disciplines involved are: mechanical, aeronautical, electrical and civil.

1701 Availability (climatology)

REFER ALSO TO CITATION(S) 28563, 28571, 28580

28536 (DOE/ET/20607—T1) Egyptian wind energy resources study. Phase II. Final report. Hughes, W.L. (Oklahoma State Univ., Stillwater (USA). Engineering Energy Lab.). Nov 1979. Contract AC02-78ET20607. 139p. NTIS, PC A07/MF A01. Order Number DE81026222.

The data gathered in Egypt in Phase I of the program indicated favorable wind energy possibilities along the Mediterranean Coast west of Alexandria and along the Red Sea south of Suez. There did not appear to be inland areas of high promise. It was decided that in Phase II, several continuous wind recording instruments would be established on the North Coast and Red Sea Coasts. Locations finally selected for the North Coast (South Coast of the Mediterranean) were distributed from Mersa Matruh to Borg El Arab, a coastal community about seventy kilometers west of Alexandria. The recorded data from the monitoring stations are presented.

28537 (P—500-80-016) Wind-energy assessment of the Palm Springs-Whitewater Region. Final report. Zambrano, T.G.; Walker, S.N.; Baker, R.W. (AeroVironment, Inc., Pasadena, CA (USA)). Mar 1980. 164p. (AV-R—9547). California Energy Resources Conservation and Development Commission, Sacramento. Order Number DE81903675.

This final report documents a jointly-sponsored field investigation of the wind energy potential of the Palm Springs-Whitewater Region (PSWR) for the Southern California Edison Company (SCE) and the California Energy Commission. Presented is a comprehensive description of all field and related activities of the one-year study period (August 1978 through July 1979); pertinent historical information; measured data; energy assessment results and wind energy conversion systems performance estimates. The report presents a framework in which data are analyzed in a manner suitable for policy and decision-making for wind energy systems in the PSWR. The study area covers the area from Beaumont, California, through the San Gorgonio Pass to the outskirts of Palm Springs.

28538 (P—500-80-054-Vol.2) Wind energy prospecting in Alameda and Solano counties. Davis, E.; Nierenberg, R. (Pacific Gas and Electric Co., San Francisco, CA (USA)). May 1980. 92p. California Energy Commission, Sacramento. Order Number DE81903665.

Appendices to the wind energy prospecting report for Alameda and Solano counties of California are presented concerning program cost data; site topographic maps; wind run data; hourly wind speed and direction; mean diurnal speed; wind turbine simulations for Alameda; and wind turbine simulations for Solano.

28539 (PNL—3214, pp 213-227) Pacific Northwest regional assessment. Barchet, W.R.; Elliott, D.L. (Battelle, Pac Northwest Lab, Richland, Wash). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

The wind energy resource of the United States and its territories must be described in adequate detail to meet the needs of a variety of users. To meet these needs, the Wind Characteristic Program Element, managed for the U.S. Department of Energy (DOE) by Pacific Northwest Laboratory (PNL), developed, applied and tested techniques using existing wind information to assess the wind energy potential of the Northwest region. This assessment included Idaho, Montana, Oregon, Washington and Wyoming. 4 refs.

28540 (PNL—3214, pp 229-241) Wind energy resource development in California. Ginosar, M.; Cook, C.; Waco, D. (Calif Energy Comm, Sacramento, Calif). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

The California Energy Commission (CEC) staff is actively engaged in wind resource development throughout the state. Since the economic feasibility of wind energy conversion systems depends heavily on the total amount of power available in a specific area, the goal is to characterize the nature of the wind resource for the many diverse wind regimes in California.

28541 (PNL—3214, pp 243-251) Alaskan wind power study. Wentink, T. Jr. (Univ of Alaska, Fairbanks). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

The objective of this paper is the determination of Alaska's wind power potential (WPP) for the eventual practical application of its wind energy. The paper deals only with wind characteristics, not applications. 10 refs.

28542 (PNL—3214, pp 253-259) Wind energy potential in the northern part of Germany. Tetzlaff, G.; Beyer, R. (Univ Hannover, Ger). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

The German wind energy program centers around a major wind turbine to be built in Germany. This wind turbine is designed to be introduced as a power plant in the main power grid. It is in particular meant to be integrated in the network of the different existing power plants. The general meteorological conditions encountered in Germany are characterized by the topography, as far as wind is concerned. 6 refs.

28543 (PNL—3214, pp 261-271) **Wind energy resource assessment of New Zealand.** Cherry, N.J. (Lincoln Coll, Canterbury, NZ). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

A program for the utilization of wind energy on a large scale in New Zealand would require a proven need for the energy: demonstration that the wind is a practical energy resource as to where and when the energy would be available, and the choice of a small number of sites for testing and evaluating pilot plants. Sufficient wind data exists in the archives of the New Zealand Meteorological Service to broadly characterize most areas of the country and to indicate a number of possible pilot plant sites as discussed. 8 refs.

28544 (PNL—3214, pp 273-283) **Meteorological and topographical indicators of wind energy for regional assessments.** Elliott, D.L. (Battelle, Pac Northwest Lab, Richland, Wash). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

Existing wind data provide the primary basis for assessing a region's wind energy potential. However, the existing wind data must be evaluated carefully to determine their representativeness of the site and local area, because wind energy is very sensitive to variations in terrain, vegetation roughness, height above ground, and instrument exposure. In analyzing the wind energy in complex terrain and data-sparse areas, the paper relies on the use of various indirect indicators of wind energy and an understanding of the physical processes and features that result in high winds in some areas but not in other areas. 2 refs.

28545 (PNL—3214, pp 285-291) **Manufacturers' view of wind resource assessments.** Wiesner, W. (Boeing Eng and Constr, Seattle, Wash). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

This paper presents a brief outline of Boeing Engineering and Construction's treatment of the several areas of wind resources now rapidly being explored and quantified in the United States. The subject matter covers a broad range of highly variable data, thus, this paper only reviews some of the aspects of how a manufacturer of large wind turbines makes use of wind resources.

28546 (PNL—3214, pp 293-303) **Agricultural applications of wind resource assessments.** Johnson, G.L.; Wagner, J. (Kans State Univ, Manhattan). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

Given the potential agricultural, utility and other markets for Wind Power Systems there exists a need for reliable information from which technical, financial and economic questions about WECS use can be answered to serve the information needs of WECS manufacturers, distributors and potential large and small-scale users. The Regional Wind Energy Resource Assessments are being designed to satisfy the need for accessible, reliable and useful wind data. 6 refs.

28547 (PNL—3214, pp 311-324) **Statistical reliability of wind power assessments.** Corotis, R.B. (Northwest Univ, Evanston, Ill). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

This paper provides working guidelines for the analysis of site wind data in the development of site and regional wind power assessments. No extensive set of background theory and data is presented here since it is available in previously published papers and reports. For National Weather Service sites hourly or 3-hourly data are normally available from the National Climatic Center (NCC). With specialized computer algorithms it is possible to analyze these data tapes to derive desired statistics such as the mean, variance and probability distributions of hourly and monthly wind speed and wind power, and temporal correlation (autocorrelation), the power spectral density and the persistence. 12 refs.

28548 (PNL—3214, pp 353-361) **Application of power laws for wind energy assessment.** Sisterson, D.L.; Hicks, B.B. (Argonne Natl Lab, Ill). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

This investigation makes use of wind data from the ANL meteorology tower in northern Illinois. For convenience, and since questions of wind energy will be addressed in which the use of the power-law wind profile is common, power laws have been fitted to actual wind profiles, and the frequency distribution of the power-law exponent has then been determined hourly, seasonally, and annually. 9 refs.

28549 (PNL—3214, pp 363-373) **Trees as an indicator of wind power potential.** Wade, J.E.; Hewson, E.W. (Oreg State Univ, Corvallis). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

With wind turbines severe winds may also cause damage to blades but contribute nothing to power generated by the system. Each generic type of wind turbine has a speed at which it begins to produce power. Trees of different generic types also have different thresholds at which they begin to display wind deformation. This paper will describe techniques for using trees as an indicator of wind power potential and their limitations as a wind prospecting tool. 5 refs.

28550 (PNL—3214, pp 375-379) **Remote sensing applications to wind power facility siting.** Rosenfeld, C.L.; Maule, P.A. (Oreg State Univ, Corvallis). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

Prospecting for wind power potential proceeds from a regional or large-area assessment to the identification of experimental sites for instrumentation with anemometers. This research is centered on an evaluation of remote sensing and associated interpretation techniques to assist in the reconnaissance for indicators of wind power potential. 2 refs.

28551 (PNL—3214, pp 381-391) **Utility and verification of mathematical windfield models for wind energy regional screening and site selection.** Traci, R.M.; Phillips, G.T.; Rock, K.C. (Sci Appl Inc, La Jolla, Calif). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

A WECS siting methodology has been developed in recent years which makes use of numerical windfield models to objectively and accurately extrapolate historical or field test data from sites within a mesoscale region of interest to other potentially "windier" sites throughout the region. As part of the development program, two windfield models have been developed for complementary use in the methodology: SIGMET, a primitive equation, terrain conformal, mesoscale meteorology model and NOABL, a simplified physics, terrain conformal windfield model. 5 refs.

28552 (PNL—3214, pp 393-404) **WECS site screening by physical modeling.** Meroney, R.N. (Colo State Univ, Fort Collins). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

This paper summarizes the results of a physical modeling program to study the interaction of wind and topography. The program's primary purpose was to provide information of use to wind-power site selection; however, the results will also be of interest to those involved in architectural planning, wind loading on buildings, forest blowdown, ballistics, or snow drifting. 11 refs.

28553 (PNL—3214, pp 405-415) **Wind energy assessment of the San Gorgonio Pass Region.** Walker, S.N.; Zambrano, T.G. (Aerovironment Inc, Pasadena, Calif). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

The San Gorgonio Pass Region has been identified as an area that may be suited for a large array of WECS. This paper reports the progress-to-date made in the Southern California Edison- and California Energy Commission-sponsored field investigation of the wind energy potential of the San Gorgonio Pass Region. The field program is organized to obtain wind information, which can be directly interpreted in terms of WECS design requirements. 5 refs.

28554 (PNL—3214, pp 417-428) **Status of the large wind turbine siting handbook.** Hiester, T.R.; Pennell, W.T. (Battelle, Pac Northwest Lab, Richland, Wash). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

Documentation of siting methodologies in handbook form is a major product of the Wind Characteristics Program Element (WCPE) of the Federal Wind Energy Program. A Siting Handbook For Small Wind Energy Conversion Systems (small WECS) (Wegley et al. 1978) was written and published by Pacific Northwest Laboratory (PNL). It is being updated according to review comments and will be republished for wider distribution. This paper describes that document which is referred to as the Large WECS Handbook (LWH). 2 refs.

28555 (PNL—3214, pp 59-69) **Model for the probability structure of atmospheric turbulence.** Dutton, J.A.; Hojstrup, J. (Pa State Univ, University Park). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

This paper reports the initial phase of an investigation into the statistical structure of turbulence in the atmospheric boundary layer. The theoretical basis is that the quantities of interest can be calculated if the joint distribution is known for various /DELTA/t. The authors propose a theoretical model for these joint distributions and then demonstrate with calculations based on two samples of data that the model is worthy of further study. 3 refs.

28556 (PNL—3214, pp 71-79) **Wind fluctuations described as discrete events.** Powell, D.C. (Batelle, Pac Northwest Lab, Richland, Wash). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

This paper discusses a wind fluctuation description that is expressed as the frequency of occurrence of some specifically defined class of turbulence events. This is called the frequency of occurrence of discrete gusts if a technical definition of gusts is given to include any series of discrete events that may be defined from a turbulence time series according to some rule of utility. If such a frequency of occurrence is known, this information may be used to calculate the frequency of occurrence of events that is harmful to machines exposed to the atmosphere. 2 refs.

28557 (PNL—3214, pp 191-205) **Potential impact of automated wind guidance on wind energy conversion operations.** Carter, G.M.; Gilhousen, D.B. (NOAA, Camp Springs, Md). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

The National Weather Service has been producing numerical-statistical forecasts of surface winds for approximately 250 locations throughout the United States. These forecasts, made by the Model Output Statistics (MOS) technique, serve primarily as guidance for aviation and public weather forecasters. This paper describes how the various MOS wind forecasts are produced and show verification results to indicate how the quality of the guidance varies with forecast projection and geographic location. The advantages and disadvantages of using the MOS approach for future energy-related applications, such as predicting hourly average winds or estimating wind power output, also are discussed. 15 refs.

1704 Economics

REFER ALSO TO CITATION(S) 28560

28558 **(P—500-81-005) Wind turbine system for high wind regions of California.** Plaks, A.; Wiesner, W.; Miller, G.E.; Nielsen, R.L. (Boeing Engineering and Construction Co., Seattle, WA (USA)). Jan 1981. 82p. California Energy Commission, Sacramento. Order Number DE81903661.

This report contains results of a study in which a variety of MOD-2 wind turbine machines were tested for use in high wind regions of California. Several sample models were evaluated to determine a total program cost when installed in clusters, in an environment similar to San Gorgonio Pass, with one billion Kwh annual generating capacity. The optimum wind turbine was determined to have a 300 foot diameter rotor and a 4 MW rating. Eighty-nine of these systems are needed to provide the required annual output at a capital outlay of $305 million (in 1980 dollars). The cost of electricity from this cluster is 5.9/Kwh. This cost is increased by 7% if installation costs (land, interconnection and construction financing) are included.

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 28536, 28537, 28538, 28546, 28551, 28552, 28553, 28554, 28555, 28556, 28557

28559 **(DOE/NASA/0163—2) MOD-OA 200 kW wind turbine generator design and analysis report.** Anderson, T.S.; Bodenschatz, C.A.; Eggers, A.G.; Hughes, P.S.; Lampe, R.F.; Lipner, M.H.; Schornhorst, J.R. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center; Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Energy Systems Div.). Aug 1980. Contract AI01-76ET20370. 393p. (NASA-CR—165128; AESD-TME—3052). NTIS, PC A17/MF A01. Order Number DE81027625.

This report documents the design, analysis, and initial performance of the MOD-0A 200 kW wind turbine generator at Clayton, NM. The MOD-OA was designed and built by the NASA Lewis Research Center for the US Department of Energy to obtain operation and performance data and experience in utility environments. This report covers the effort from 1975 to March 1978, when the MOD-OA was released to the Clayton utility for operation. This report discusses the project requirements, approach, system description, design requirements, design, analysis system tests, installation, safety considerations, failure modes and effects analysis, data acquisition, and initial performance for the wind turbine. The design and analysis of the components and systems are presented.

28560 **(DOE/NASA/20305—5) Mod-2 wind turbine development project.** Linscott, B.S.; Dennett, J.T.; Gordon, L.H. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jul 1981. Contract AI01-77ET20305. 23p. (NASA-TM—82681). NTIS, PC A02/MF A01. Order Number DE81027522.

A major phase of the Federal Wind Energy Program, the Mod-2 wind turbine, a second-generation machine developed by the Boeing Engineering and Construction Co. for the US Department of Energy and the Lewis Research Center of the National Aeronautics and Space Administration, is described. The Mod-2 is a larger (2.5-MW power rating) horizontal-axis wind turbine designed for the generation of electrical power on utility networks. Three machines have been built and are located in a cluster at Goodnoe Hills, Washington. All technical aspects of the project are described: design approach, significant innovation features, the mechanical system, the electrical power system, the control system, and the safety system.

28561 **(DOE/R5/10236—2) Hydraulic wind energy conversion system.** (Jacobs Energy Research, Inc., Audubon, MN (USA)). Jul 1981. Contract FG02-80R510236. 18p. NTIS, PC A02/MF A01. Order Number DE81027122.

The purpose of this research was to design, build and test a hydraulic wind energy system. This design used a three bladed turbine, which drove a hydraulic pump. The energy is transmitted from the pump through a long hose and into a hydraulic motor, where the energy is used. This wind system was built and tested during the winter of 1980-1981. The power train included a five meter, three bladed wind turbine, a 9.8:1 ratio gearbox, a 1.44 cubic inch displacement pump with a small supercharge gear pump attached. The hydraulic fluid was pumped through a 70', 3/4" I-D-high pressure flexhose, then through a volume control valve and into a 1.44 cubic inch displacement motor. The fluid was returned through a 70', 1" I-D-flexhose.

28562 **(P—500-80-054-Vol.1) Wind energy prospecting in Alameda and Solano counties.** Davis, E.; Nierenberg, R. (Pacific Gas and Electric Co., San Francisco, CA (USA)). May 1980. 65p. California Energy Commission, Sacramento. Order Number DE81903664.

The Pacific Gas and Electric Company and the California Energy Commission conducted a wind energy prospecting program in Northern California. Eight candidate areas were initially considered and qualitatively evaluated; two areas in the San Francisco Bay Area were selected for study. A total of 23 sites were instrumented at the 30-ft level. Data were collected and analyzed for the ten-month period of March through December, 1979. The procedures used to define candidate measuring sites are discussed. Final site selection reflected the initial desired network configuration and the reality of access, land use and representativeness of individual sites.

28563 (PNL—3214, pp 329-341) **Characteristics of airflow over certain topographic features.** Wooldridge, G.L. (Utah State Univ, Logan). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

An almost infinite number of terrain configurations intercept and interact with a continuum of wind patterns in an airflow which may exhibit a wide range of static stabilities. This presents a formidable problem to those investigators who would like to generalize the behavior of air flowing over, around, and through characteristic terrain features. This paper will deal with the characteristic behavior of airflow on the mesoscale, and not on the details of flow in the atmospheric boundary layer in the vicinity of small obstacles. 15 refs.

28564 (PNL—3214, pp 13-29) **Atmospheric considerations for design of WECS.** Thresher, R.W. (Oreg State Univ, Corvallis). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

The key objective of current wind turbine design efforts is to reduce the cost of energy to a minimum, and still provide a safe and reliable turbine system. The major thrust of supporting research and technology development programs should be directed toward this same goal. To focus attention on the relationship between the cost of energy (COE) and atmospheric considerations, this paper examines the factors involved to determine the important atmospheric contributions.

28565 (PNL—3214, pp 31-45) **Analysis of wind speed characteristics for design criteria development in the Kaman/DOE 40-kW wind turbine generator program.** Bowes, M.A.; Perley, R. (Kaman Aerosp Corp, Bloomfield, Conn). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

This project is to design and fabricate a 40-kW horizontal axis wind turbine generator. This work is part of the Small Wind Energy Conversion Systems (SWECS) development program that is being directed by Rockwell International. The 40-kW WTG system is the result of an extensive analysis and design effort which was predicated on achieving the lowest system cost consistent with the established performance requirements. Central to this effort were the development and application of design evaluation criteria based on statistical wind speed models. 2 refs.

28566 (PNL—3214, pp 47-58) **Modified power law equations for vertical wind profiles.** Spera, D.A.; Richards, T.R. (NASA, Lewis Res Cent, Cleveland, Ohio). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

Up until now, the effects of wind speed and surface roughness have only been considered separately. As shown in this paper, several functional relationships have been proposed for the variation of the exponent alpha with wind speed. Information on the separate effects of wind speed and surface roughness is available, but a wind profile model which combines these two effects is lacking. The objective of this paper, then, is to present equations relating the mean value of alpha to both the surface roughness and the steady wind speed. Other factors are assumed to be responsible for statistical variations about this mean value. 14 refs.

28567 (PNL—3214, pp 81-90) **Wind statistics at the Boulder Atmospheric Observatory tower.** Kaimal, J.C. (NOAA, Boulder, Colo). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

This paper presents recent analyses of wind fluctuation data obtained from the 300-m tower at the Boulder Atmospheric Observatory (BAO). The analyses are part of an ongoing effort to provide turbulence statistics for use in the design of wind turbine generators. The performance and life expectancy of large rotor blades are directly affected by such factors as the vertical gradient of the horizontal wind velocity, wind direction variability with time, and gust distribution over the plane of the blades. 5 refs.

28568 (PNL—3214, pp 91-101) **Effect of complex terrain on wind fluctuations.** Panofsky, H.A.; Vilardo, J.M.; Shirer, H.N.; Lipschutz, R.C.; Larko, D.E. (Pa State Univ, University Park). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

The purpose of this paper is to describe techniques which make possible the estimation of certain statistics of the natural wind from easily accessible meteorological and terrain variables, with emphasis on strong winds and on complex terrain. The statistics investigated are variances and spectra of the three wind components. This discussion indicates that it is not sufficient to study variances; the spectral composition is also needed in order that the variances over proper frequency bands can be found. 12 refs.

28569 (PNL—3214, pp 113-130) **Some meteorological activities in the national Swedish wind energy program.** Faxen, T. (Univ of Uppsala, Swed). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

Two major projects conducted by the University of Uppsala's Department of Meteorology on behalf of the National Swedish Board for Energy Source Development are discussed. First, the meteorological field station at Sweden's 60-kW windmill is presented. Then, the Gotland-Skane project, which was to determine sites for two 1- to 2-MW prototype windmills, is described. 10 refs.

28570 (PNL—3214, pp 169-177) **Method for estimating the impact of WECS on utility operating reserve requirements.** Goldenblatt, M. (JBF Sci Corp, Wilmington, Mass). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

The subject dealt with in this paper is how to determine the impact Wind Energy Conversion Systems (WECS) would have on a utility's generating mix. The method utilized for determining this impact is to assume that present on-line operating reserves are based upon a utility's ability to satisfy its load requirements 99% of the time. 3 refs.

28571 (PNL—3214, pp 305-310) **Wind energy from a utility planning perspective.** Butler, N.G. (Bonneville Power Adm, Portland, Oreg). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

In assessing the potential for the generation of electrical energy from the wind, a utility would have to address the various questions. This paper describes one method a utility could use to assess the potential for wind generation. The primary objective would be to extract the maximum amount of energy per year at the lowest cost. 1 ref.

28572 (PNL—3214, pp 131-139) **Turbulence and WTG performance.** Kirchhoff, R.H. (Univ of Mass, Amherst). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

The University of Massachusetts 25-kW wind turbine has been instrumented (Murphy and Kirchhoff 1979) to determine its steady state and dynamic operating characteristics. The results presented in this paper focus on the dynamic response of the turbine. R.M. Young Gill type anemometers are used to measure the turbulent wind characteristics. Generator output and other response characteristics of interest are recorded on FM tape. 4 refs.

28573 (PNL—3214, pp 141-150) **Wind turbine dynamic blade loads due to wind gusts and wind direction changes.** Stoddard, W. (US Windpower Assoc, Burlington, Mass). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

A simple methodology has been developed for the calculation of blade dynamics and vibration for rotor-type wind turbines. The method employs equations of motion of the slender rotor blade in the flapping (out of plane), lead-lag (inplane), and torsional (feathering) degrees of freedom. Blade motions, forces and moments can be found for perturbations due to gravity, crosswind, yaw rate, and axisymmetric flow. 3 refs.

28574 (PNL—3214, pp 179-189) **Use of wind data with an operational wind turbine in a research and development environment.** Neustadter, H.E. (NASA, Lewis Res Cent, Cleveland, Ohio). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

The Department of Energy identified 17 candidate sites for detailed evaluation as potential sites for installation of large, horizontal axis Wind Turbines (WT), as part of its Wind Energy Program. From these initial sites, four were subsequently selected for installation of the WT, known as Mod-OA. This paper describes the Mod-OA WT. The following sections describe the meteorological data collected, show some of the analyses based on these wind data, and discuss additional areas currently being investigated in relation to these data. 9 refs.

28575 (PNL—3214, pp 343-351) **Boundary layer wind shear.** Heald, R.C. (Oreg State Univ, Corvallis). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

The development of modern horizontal axis wind turbines has created a need to know the characteristics of the wind field to which the turbine is exposed. Vertical wind shear is one important factor affecting turbine design. As the blades of a horizontal axis turbine rotate, they will sweep through air moving at different speeds and directions and thereby be subjected to variable loads. This study presents statistics on boundary layer wind shear and its diurnal variation from wind measurements at several locations over level terrain. 8 refs.

28576 (PNL—3214, pp 103-112) **Data analysis at the Rocky Flats Wind Systems Test and Development Center.** Hansen, A.C. (Rockwell Int, Rocky Flats, Colo). 1979. American Meteorological Society, 45 Beacon St., Boston, MA $27.00.

From Conference and workshop on wind characteristics and wind energy siting; Portland, OR, USA (19 Jun 1979).

At the Rocky Flats Wind Systems Test and Development Center, data analysis techniques are in use that permit meaningful and useful interpretation of every instant in the operation of SWECS in random winds. This paper will discuss three of the methods in use and give examples of their application using samples of data from an Enertech 1500 and a Jacobs 3 kW-system. 3 refs.

28577 **(SERI/CP—635-1061) SERI second wind energy innovative systems conference.** (Solar Energy Research Inst., Golden, CO (USA)). 1980. Contract AC02-77CH00178. 209p. (CONF-801223—(Vol.2)). NTIS, PC A10/MF A01. Order Number DE81027876.

From 2. wind energy innovative systems conference; Colorado Springs, CO, USA (3 Dec 1980).

Separate abstracts are included for each of the papers presented concerning unusual types of wind energy conversion systems.

28578 **(RFP—3025/64410/3533/79/16-2) Development of a 2-kilowatt high-reliability wind machine. Phase I. Design and analysis. Volume II. Technical report.** Drake, W.; Clews, H.; Cordes, J.; Johnson, B.; Murphy, P. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant; Enertech, Norwich, VT (USA)). Jan 1980. Contract AC04-76DP03533. 90p. NTIS, PC A05/MF A01. Order Number DE81028605.

A high reliability wind machine rated for 2 kW at 9 m/s has been designed to be cost-effective for remote site use. To meet or exceed environmental conditions as specified in Contract PF64410F, the resulting design defines a rugged, relatively simple wind machine. Rigorous fatigue analysis for structural components and development of redundant systems for electrical components led to an expected mean time between failures of 12.35 years. Approximately one year into the research and development program a completed design meeting contract stipulations is being submitted to the contract buyer. The design is for a horizontal axis, downwind machine with two wooden blades spanning 5 meters diameter. Positive rotor speed control is accomplished through a centrifugally governed variable pitch stalling rotor. Design merits have been confirmed through dynamic truck testing.

28579 **(RFP—3025/64410/3533/79/16-1) Development of a 2-kilowatt high-reliability wind machine. Phase I. Design and analysis. Volume I. Executive summary.** Drake, W.; Clews, H.; Cordes, J.; Johnson, B.; Murphy, P. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant; Enertech, Norwich, VT (USA)). Jan 1980. Contract AC04-76DP03533. 25p. NTIS, PC A02/MF A01. Order Number DE81028635.

A high reliability wind machine rated for 2 kW at 9 m/s has been designed to be cost-effective for remote site use. To meet or exceed environmental conditions as specified in Contract PF64410F, the resulting design defines a rugged, relatively simple wind machine. Rigorous fatigue analysis for structural components and development of redundant systems for electrical components led to an expected mean time between failures of 12.35 years. Approximately one year into the research and development program, a completed design meeting contract stipulations is being submitted to the contract buyer. The design is for a horizontal axis, downwind machine with two wooden blades spanning 5 meters diameter. Positive rotor speed control is accomplished through a centrifugally governed variable pitch, stalling rotor. Design merits have been confirmed through dynamic truck testing.

28580 Measurement strategies for estimating long-term average wind speeds. Ramsdell, J.V.; Houston, S.; Wegley, H.L. (Battelle, Pac Northwest Lab, Richland, Wash). *Solar Energy ;* **25**: No. 6, 495-503(1980).

The uncertainty and bias in estimates of long-term average wind speeds inherent in continuous and intermittent measurement strategies are examined by simulating the application of the strategies to 40 data sets. Continuous strategies have the smaller uncertainties for fixed duration measurement programs, but intermittent strategies make more efficient use of instruments and have smaller uncertainties for a fixed amount of instrument use. 8 refs.

28581 Utility operational experience on the NASA/DOE MOD-OA 200 KW wind turbine. Glasgow, J.C.; Robbins, W.H. (NASA, Lewis Res Cent, Cleveland, Ohio). pp 29-37 of Electron conference and exposition. Piscataway, NJ; Institute of Electrical and Electronics Engineers (1979).

From Electron conference and exposition; Cleveland, OH, USA (5 Jun 1979).

The Mod-OA 200 kW Wind Turbine was designed and fabricated by the Lewis Research Center of NASA under the direction of the U.S. Department of Energy. The project is a part of the Federal Wind Energy Program and is designed to obtain early wind turbine operational and performance data while gaining initial experience in the operation of large, horizontal axis wind turbines in typical utility environments. On March 6, 1978 the Mod-OA wind turbine was turned over to the Town of Clayton Light and Water Plant, Clayton, NM, for utility operation and on December 31, 1978, the machine had completed ten months of utility operation. This paper describes the machine and documents the recent operational experience at Clayton, NM.

20 ELECTRIC POWER ENGINEERING

REFER ALSO TO CITATION(S) 28816, 28820

28582 (CONF-8104100—1) Limits on power injections for security-constrained power flows. Wu, F.F.; Kumagai, S. (California Univ., Berkeley (USA)). 1981. Contract AC01-79ET29364. 4p. NTIS, PC A02/MF A01. Order Number DE81025981.

From IEEE international symposium on circuits and systems; Chicago, IL, USA (27 Apr 1981).

A power system in steady-state is described by a set of nonlinear equations known as the power flow equations. The system has to be operated within the operating limits of the equipment. This is described by a set of inequality constraints, known as the security constraints. The steady-state security analysis problem is formulated as one of determining the existence of solutions to the power flow equations in the region defined by the security constraints. Explicit limits on the amount of power generation and load demand within which the system can be operated with all the security constraints satisfied are obtained.

28583 (CONF-8104100—2) Stability region in the pre-fault state space. Kaye, R.J.; Wu, F.F. (California Univ., Berkeley (USA)). 1981. Contract AC01-79ET29364. 3p. NTIS, PC A02/MF A01. Order Number DE81025980.

From IEEE international symposium on circuits and systems; Chicago, IL, USA (27 Apr 1981).

Direct methods of power system stability analysis result in a region in the post-fault state space. For dynamic security assessment one is interested in finding a region of security operation in the pre-fault state space that guarantees the stability of the post-fault system. The problem of finding the corresponding region in the pre-fault state space from a post-fault stability region is considered. A relation between the full pre-fault stability region and one obtained by using any approximation of the fault-on dynamics is obtained. A method for finding a pre-fault stability region is proposed.

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REFER ALSO TO CITATION(S) 28054, 28107, 28134, 28138, 28149, 28637, 28638, 28639, 28681, 28740, 28748, 28784, 28785, 28786, 28822, 28909, 28984

28584 (CONF-810498—(Vol.1), pp 113-123) **FPL's Sanford COM demonstration project.** Slepow, L.D.; Mendelssohn, A.S. (Florida Power & Light Co., Miami). 1981. NTIS, PC A20/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

Florida Power & Light Company has conducted a comprehensive test of coal-oil mixture, or COM, as an alternate boiler fuel in Sanford Unit No. 4, a 400 megawatt unit, to determine the problems associated with burning coal in a boiler which originally was designed to burn oil. FPL has undergone this test because of its desire to reduce its dependence on oil. Within its generation sytem there are nine 400 MW units and four 800 MW units, all designed to burn oil, and all are candidates for an alternate fuel. This presentation will give a detailed look at the preparation plant that was built to make COM for the demonstration and the modifications that FPL made to the Sanford Plant in order to allow it to burn COM. The problems that developed during the demonstration will be addressed. In addition, some of the operation lessons learned in the handling and burning of COM will be discussed. A summary of the results generated in burning COM with up to a 50% coal concentration will also be presented.

28585 (CONF-810498—(Vol.1), pp 141-157) **Demonstration test at Takehara No. 1 & 2 units.** Nakabayashi, Y.; Yugami, H.; Hatano, Y. (Electric Power Development Co., Ltd., Tokyo, Japan). 1981. NTIS, PC A20/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

The bench tests and pilot tests have been completed of the COM for utility boiler use developed by Electric Power Development Co., Ltd. (EPDC), and have entered the demonstration test stage. In Japan, the main use of COM is in the conversion of fuel burned in existing oil-fired design boilers. The demonstration test has been divided into two stages; a first stage test using the 250 MW No. 1 Coal Unit of the Takehara Power Station, and a main test using the 350 MW No. 2 Unit at the same station. The main test is scheduled to be performed by EPDC, as entrusted by the government. The first stage test will be performed for a period of abut one year from March 1981, and the main test will be carried out for 1.5 years from October 1983. In this paper, the design and construction characteristics of the first-stage test facilities and various problems associated with the technology of the main test are discussed.

28586 (CONF-810498—(Vol.2), pp 494-508) **Planning for COM conversion.** Bavington, A.F. (Jacksonville Electric Authority, FL); Kimel, E.A. 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

Jacksonville Electric Authority (JEA) is considering conversion of their 134 MW D. Kennedy No. 10 generating unit to coal-oil-mixture (COM) firing. The results of the investigations made to determine the feasibility of conversion to COM fuel are presented. Criteria for COM fuel selection and the required plant modifications are described. Considerations involved in selection of major equipment are presented. Overall planning and scheduling are discussed. Long-lead procurement items are identified, and suggestions to enable early procurement of critical components are given. The estimated capital cost of converting the unit to COM fuel firing is presented. On the basis of the projected capital and operating costs, the economic benefits of converting to COM fuel are evaluated. The conversion is determined to be technically feasible and attractive.

28587 (CONF-810498—(Vol.2), pp 509-525) **Technique for conversion of fuel oil boiler to COM combustion.** Koda, F. (Babcock Hitachi K.K., Tokyo, Japan). 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

This paper presents a design study for conversion of a boiler currently burning fuel oil to coal oil mixture (COM). In boiler conversion to COM firing, there is considerable difference in the modification range, depending on the design conditions for the original boiler. Major factors in the design and operation of a COM fired boiler are the quantity of ash and the physical and chemical characteristics of the coal ash. COM usually contains approximately 5% of coal ash, therefore, countermeasures for the following must be considered in the conversion of a boiler. (1) high temperature ash deposition on the furnace and convection tube surfaces; (2) metal loss due to erosion; (3) removal and discharge of ash accumulations; (4) air pollution due to NO/sub x/, SO/sub x/ and fly ash particles. Also, the pulverized coal in the COM, which burns more slowly than fuel oil, must be burned completely in the small furnace designed for oil firing. This paper covers study results regarding the above considerations.

28588 (CONF-810498—(Vol.2), pp 526-540) **Experimental investigations about COM combustion in a 4 MW furnace and fundamental erosion-corrosion phenomena in slurry systems.** Ravnsborg, J. (Studsvik Energiteknik AB, Nykoeping, Sweden). 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

The COM-activities at Studsvik Energiteknik AB are focused on the introduction of coal slurries in small and medium sized units designed for oil firing. This paper presents two projects - dealing with combustion aspects/fuel system lay-out and erosion/corrosion in the fuel system repectively. Equipment and programmes are described together with experiences gained during shake-down tests with the combustion rig.

28589 (CONF-810498—(Vol.2), pp 903-923) **Preliminary evaluation of technical, environmental, and economic feasibility of using coal/oil mixtures in two California powerplants.** Lips, H.; Derbidge, C. (Acurex Corp., Mountain View, CA). 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

A preliminary investigation of the technical, environmental, and economic feasibility of converting two California powerplants to coal-oil mixture (COM) firing was conducted. The applicability of various pollution control techniques for NO/sub x/, SO/sub x/ and particulate at the two sites was examined. Conceptual designs for an off-site COM preparation plant, transportation network, and powerplant modifications were developed and areas of significant technical concern delineated. Based on these conceptual designs life-cycle economic analyses were performed. Major findings are that, for the California powerplants considered, significant uncertainties still exist with respect to: COM transportation networks and stability; COM pollution control regulations and technologies for NO/sub x/, SO/sub x/ and particulate; boiler operation and maintenance with respect to derate, slagging, and fouling and erosion and/or plugging of auxiliary equipment. If key uncertainties can be resolved favorable, then COM conversion may be economically attractive for the sites considered.

28590 (CONF-810498—(Vol.2), pp 924-935) **California air quality regulations and coal-oil mixture combustion: a preliminary assessment.** Swett, G.H. (Robert Brown Associates, Carson, CA). 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

California is the largest single geographic market for coal-oil mixtures (COM) in the United States. The potential market is estimated to be as large as 620,000 barrels of oil per day. The major impediment to the use of COM in California is the belief that air quality restrictions would prohibit its use. However, no documentation of air quality regulations and their effect on COM combustion in California is available. This assessment indicates that existing sulfur restrictions can be met for the San Francisco Bay area and San Diego area generating stations by the use of low sulfur coal from Utah and very low sulfur residual oil. Flue gas desulfurization will be required to meet Los Angeles sulfur California regulations. Emissions of oxides of nitrogen will be higher and will cause the major air quality permitting problems. California air quality regulations require that increased emissions from the combustion of COM be offset so that the net increase in emissions is less than zero. This preliminary assessment indicates that the demand for electricity generated by oil and gas power plants will be substantially reduced in the future. This is due to increased supplies of nuclear and coal generated power. Emissions of NO/sub x/ from oil and gas fired power plants will be further reduced by larger supplies of natural gas. Emissions are projected to be reduced sufficiently to allow substitution of COM for the 100,000 barrels per day of fuel oil projected to be consumed in the future by electrical generating stations. This would reduce demand for foreign oil by 30,000 to 40,000 barrels per day.

28591 (CONF-810498—(Vol.2), pp 936-965) **Full scale test firing coal-oil mixtures in a 400 MW steam generator.** Schmidt, A.D. (Florida Power and Light Co., Miami); Friedrich, J.L. 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

The paper addresses the technical aspects of coal-oil mixture firing in a 400 MW oil fired central station utility reheat steam generator. The authors specifically discuss the tests conducted on Florida Power and Light Company's Sanford Unit No. 4 steam generator. The purpose of this test program was to determine whether or not coal-oil mixtures could be burned effectively and efficiently. This is the first comprehensive large scale COM demonstration project to accumulate significant long-term operation in a steam generator originally designed to burn oil. Test procedures and instrumentation are summarized. Tests were conducted at various load levels using multiple weight COM ratios of coal to oil ranging from 20/80 to 50/50. Technical review assesses overall boiler and individual component performance both functionally and mechanically with COM firing. Evaluation and observations address: boiler efficiency, capacity thermal performance, combustion characteristics, COM ash characteristics and deposition, flue gas emissions, and effects of erosion or corrosion. Results presented encompass the initial phase of the boiler testing program directed at ultimately firing a 50/50 coal-oil mixture. Boiler modification undertaken during the progress of the test program to facilitate COM firing is discussed. Technical recommendations and considerations to retrofit an oil-fired central station steam generator for COM firing are presented.

28592 **(EPRI-AP—1882-Vol.1) Baseline data on utilization of low-grade fuels in gas-turbine applications. Volume 1. Economic comparisons. Final report.** Burgess, R.J. (Florida Power and Light Co., Miami (USA)). Jun 1981. 132p. NTIS, PC A07/MF A01. Order Number DE81903806.

A project designed to characterize the costs and operating factors of a combined cycle power plant when firing No. 2 fuel compared to firing a blended low sulfur residual fuel oil is described. Results are based on exclusively firing No. 2 oil in one 260 MW(e) unit comprised of two gas turbines, two HRSG's and a steam turbine, while firing the lower grade fuel in the twin 260 MW(e) unit under as similar load and weather conditions as practicable. Because of the relative newness of the plant at the start of the test, some operating problems with heavy fuel firing affecting reliability and costs were encountered that were later resolved as operators became more proficient. These problems on heavy fuel included fuel filter plugging, flow divider failure, combustor and turbine deposition, apparent compressor surge, and oily fuels wash system effluent water. Though these circumstances tended to mask the exact cost differentials between operations on the two fuels, it is found that a $2.00/bbl fuel price differential justifies using the lower grade fuel at all capacity factors when the plant is already equipped to handle heavy fuels. For a plant that is not equipped to fire heavy fuels, if a $12.5 million fuel cleaning system investment is made at a 23% levelized annual carrying charge, a $2.00/bbl fuel price differential breaks even at a 0.5 capacity factor despite the higher maintenance costs and fuel cleaning costs incurred when firing low grade fuel.

28593 **(EPRI-CS—1915) Advanced Concepts Test (ACT) facility. Summary safety report.** Allemann, R.T. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1981. Contract AC06-76RL01830. 31p. NTIS, PC A03/MF A01. Order Number DE81026300.

As a test of a water-conserving way of cooling thermal power plants, a large-scale test of dry/wet cooling using the ammo-

nia phase-change system, designated the Advanced Concepts Test (ACT), is being constructed at Pacific Gas and Electric Company's Kern Station at Bakersfield. This report is a summary of the safety analyses and considerations that have been done for the facility. These show that the ACT facility is an industrially safe system, and that the safety precautions taken assure that no one will be injured during the course of the testing. The application of industrial codes, safety management, and operational and emergency procedures is discussed.

28594 **(EPRI-CS—1926) Deposition and corrosion phenomena on aluminum surfaces under deluged dry cooling-tower condisions. Interim report.** Wheeler, K.R.; May, R.P.; Douglas, J.G.; Tylczak, J.H. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1981. Contract AC06-76RL01830. 88p. NTIS, PC A05/MF A01. Order Number DE81025483.

Deposition and corrosion on aluminum heat exchanger surfaces resulting from deluge in wet/dry cooling towers is simulated in a laboratory Corrosion/Deposition Loop (CDL). Heat exchanger deposition buildup was found to be linearly dependent on concentration factor and number of wet/dry cycles. Deionized water rising after deluge reduced rate of deposition. Laboratory data obtained from CDL relates directly to operation of the Advanced Concepts Test (ACT) demonstration cooling tower. Technology transferable to ACT shows that deposition from supersaturated solution can be effectively controlled by attention to water chemistry, pH, water conditioning, and good heat transfer design. The additional mechanism of deposition by water film evaporation is effectively managed by soft water rinsing and uniform surface wetting. Exposure of a model TRANE surface (the ACT wet/dry exchanger) produced short-term deposition extrapolating to 0.011 mm buildup in three years. Studies continue to verify 4X as maximum cycles of concentration through control of water chemistry and rinsing after deluge. Deluge water used at ACT facility is sufficiently aggressive to warrant use of Alclad to extend tube service life.

28595 **(EPRI-WS—80-121) Deposition in utility gas turbines.** (Electric Power Research Inst., Palo Alto, CA (USA)). May 1981. 301p. (CONF-8010201—). NTIS, PC A14/MF A01. Order Number DE81903286.

From Workshop on deposition in utility gas turbines; Palo Alto, CA, USA (30 Oct 1980).

This report contains the proceedings of the Workshop on Deposition in Gas Turbines, October 30 and 31, 1980, at Palo Alto, California. The workshop was concerned with the results of several EPRI projects which had tasks concerning deposition in gas turbines. The speakers' presentations during the first day were concerned with discussions of deposition data, their analyses, and comparisons with other laboratory and field data. Similarities and differences of the various presentations were then outlined. The second day was devoted to a roundtable discussion which concerned the reconciliation of differences of the data. Emphasis was on the importance of impurities which act as stickum for the deposition and also on the physical conditions at the vane's surface which determine the stickum's adherence. Although the workshop did not provide a complete understanding of the deposition mechanisms, the workshop did provide the field practitioner with a more complete view of the data and analysis correlations obtained by others. Separate abstracts were prepared for 11 of the presentations.

28596 **(EPRI-WS—80-132) Workshop proceedings: combustion turbine residual oil.** (COECORP, Mountain View, CA (USA)). May 1981. 291p. (CONF-8007109—). NTIS, PC A13/MF A01.

From Combustion turbine residual oil workshop; Atlanta, GA, USA (17 Jul 1980).

Nine papers were presented at the meeting. A separate abstract was prepared for each paper. (LCL)

28597 (EPRI-WS—80-132, pp 96p, Paper 1) **Progress in heavy fuels.** Hefner, W.J.; Lordi, F.D. (General Electric Co., Schnectady, NY). May 1981. NTIS, PC A13/MF A01.

From Combustion turbine residual oil workshop; Atlanta, GA, USA (17 Jul 1980).

The General Electric Co. has designed and built 239 gas turbines that have operated more than 3.7 million h on heavy oil fuels. These units have been used in electric utility, industrial power generation, mechanical drive, railroad locomotive, pipeline, and ship propulsion applications. This experience is summarized and technical developments that have led to the ability to operate reliably and efficiently on heavy oil fuels are described in detail. These technical improvements involve: combustion system design, turbine gas path design, development of corrosion-resistant hot gas path materials, research on turbine deposits, fuel treatment and additives, and turbines accessory systems, e.g., fuel handling equipment, turbine cleaning systems, and air pollution control equipment. (LCL)

28598 (EPRI-WS—80-132, pp 31p, Paper 2) **United Technologies residual oil experience.** Dvorak, H.; Cartona, F. (United Technologies, South Windsor, CT). May 1981. NTIS, PC A13/MF A01.

From Combustion turbine residual oil workshop; Atlanta, GA, USA (17 Jul 1980).

The use of fuel alternatives to petroleum distillates to provide a broad fuel capability for the FT4 gas turbine was investigated. The alternative fuels used and the turbine applications included: low carbon residual oil in ship propulsion turbines and in Florida Power peak power generation, crude oil as an emergency fuel for Arabian pipeline pumping, and alcohol fuels, i.e., methanol and ethanol, for electric power plants. The fuel characteristics, combustion products, deposits on turbine vanes, turbine corrosion, fuel processing systems, turbine operating conditions and performance data are discussed. (LCL)

28599 (EPRI-WS—80-132, pp 33p, Paper 3) **Residual oil operating experience with Westinghouse industrial combustion turbines.** Strong, R.E.; Sherlock, T.P. (Westinghouse Electric Corp., Concordville, PA). May 1981. NTIS, PC A13/MF A01.

From Combustion turbine residual oil workshop; Atlanta, GA, USA (17 Jul 1980).

Westinghouse's experience with industrial turbines burning residual fuels began with a demonstration locomotive in 1947. Since then 400,000 h of operation burning all types of residual oils in industrial turbines has resulted in extensive data on operating conditions and the solution of operating problems. Laboratory data are presented on the corrosion resistance of turbine alloys, particle deposition rates for various hot gas temperatures, fuel characteristics, methods for improving turbine reliability and performance, and fuel handling and treatment. It is concluded that residual oil can be used as a combustion turbine fuel with minimum impact on performance, availability, and starting reliability. Corrosion is a potential problem that can be controlled with proper water washing of the fuel and the use of additives to control vanadium. Fuel handling and monitoring are more complex with residual fuels and will require more attention during daily operation than No. 2 distillate. High starting reliability has been achieved with duel fuel operation, in spite of the poorer combustion properties of residual fuels. Availability may be affected because of the requirement for water washing, but this effect will be negligible on peaking and intermediate duty machines. Economics can favor the burning of residual oil, but the final decision will depend on relative costs of distillates versus residuals, costs of equipment modifications, and expected usage mode for the combustion turbine. Deposition will continue to be a major concern with residual fuels, but future development of on-line cleaning techniques will minimize its impact. (LCL)

28600 (EPRI-WS—80-132, pp 24p, Paper 4) **Heavy oil use in stationary gas turbines.** McCrank, J.M. (Brown Boveri Turbomachinery, Inc., St. Cloud, MN). May 1981. NTIS, PC A13/MF A01.

From Combustion turbine residual oil workshop; Atlanta, GA, USA (17 Jul 1980).

The worldwide fuel situation has placed increased interest in heavy oils as fuels for gas turbine power generation. Experience in the use of heavy oil fuel has been derived both from crude and residual oil burning. Based on this experience, the properties of typical fuel oils are compared to recommendations for both ideal and normally economical fuel oils and the potential problem areas and solutions relating to these properties are summarized. Design considerations in the fuel supply and treatment systems, combustion

equipment, and gas turbine are discussed. Turbine fouling and corrosion and emissions control are described. The experience of Brown-Boveri Turbomachinery, Inc., which has put more than 70 gas turbines burning crude or heavy oil into service, shows that trouble-free satisfactory operation with heavy fuels can be obtained providing that extra precautions are taken to limit high temperature corrosion, fouling, and to resolve specific fuel handling problems. (LCL)

28601 (EPRI-WS—80-132, pp 7p, Paper 5) **Florida Power Corporation experience operating gas turbines on residual fuels.** Allen, H.L. (Florida Power Corp., St. Petersburg). May 1981. NTIS, PC A13/MF A01.

From Combustion turbine residual oil workshop; Atlanta, GA, USA (17 Jul 1980).

Experience at DeBary, Florida in the operation of a 311 MW power plant which uses 6 gas turbines burning residual oil is discussed with information on the fuel treatment system, fuel characteristics, treatment cost of 50 cents per barrel, and turbine performance and maintenance. The turbine parts, with properly treated and inhibited oil, are giving excellent service. The corrosion is comparable to Number 2 oil operation. Turbine deposits have been 90 to 95% water washable, and with cyclic type operation, most of the deposits come off during startup without water wash. A 185 h continuous operation test was run to determine the effects of continuous operation. About 5% loss in output during the test was noted, which could be attributed to heavy oil as a result of turbine deposits. The engine has been operated about 500 h on heavy oil to date, and a hot session was just completed. The turbine appears in excellent condition. The prototype combustion chambers had some burning in the front end. This was expected, and a later-designed chamber is now being installed for test. Again, the auxiliary equipment and fuel handling seem to be a bigger problem than the actual turbine parts. (LCL)

28602 (EPRI-WS—80-132, pp 30p, Paper 6) **Florida Power and Light Putnam Station operations.** Moss, D. (Florida Power and Light Co., Miami). May 1981. NTIS, PC A13/MF A01.

From Combustion turbine residual oil workshop; Atlanta, GA, USA (17 Jul 1980).

The Putnam Power Plant in Florida has two combined-cycle units, whose residual oil-fueled gas turbines and steam turbines are used to produce 260MW of power per unit. The operation and maintenance of the power units and thier auxiliary equipment are described. The design and performance of fuel handling and treatment facilities are discussed. Data for unit availability from December 1978 through April 1980 are presented. Fuel filter plugging problems are described. One-hundred micron filters were substituted for 75 micron filters with no adverse effects on the fuel oil delivery system components. The fuel treatment system at the Putnam Plant has been very reliable in treating the fuel to acceptable specifications. The problem of how to treat and dispose of waste water from the fuel treatment system in order to meet EPA regulations remains to be solved. (LCL)

28603 (EPRI-WS—80-132, pp 6p, Paper 7) **Long Island Lighting Company experience with heavy fuels.** Knauf, C.L. Jr. (Long Island Lighting Co., Hicksville, NY). May 1981. NTIS, PC A13/MF A01.

From Combustion turbine residual oil workshop; Atlanta, GA, USA (17 Jul 1980).

Long Island Lighting Company (LILCO) has had two experiences with the use of heavy fuels in combustion turbines. The first was in the early 70's with so-called light residual oil supplied by New England Petroleum Company (NEPCO). The second, now in progress, relates to shale oil tests being conducted for EPRI. A comparison of the properties of these heavy fuels along with Number 2 fuel oil, which is a standard-weight oil normally in use, is presented. The two primary problems with the use of NEPCO oil were contaminated with sodium and the required electrical heating. It was found that NEPCO oil with more than 3 ppM sodium was not acceptable and that special care must be taken in the installation of the oil heating system in order to insure heating of the oil all along the distributive piping. It was found that the combustion turbines operated reliably on heavy oil, there were no freeze-ups nor added not-section maintenance, and plant emissions were comparable to those from the burning of lighter Number 2 oil. Tests underway for evaluating shale oil as a fuel for gas turbine plants are briefly described. (LCL)

28604 (EPRI-WS—80-132, pp 14p, Paper 8) **Operational problems and solutions of gas turbine liquid fuel systems: a survey report.** Lukas, H. (ENCOTECH, Inc., Schenectady, NY). May 1981. NTIS, PC A13/MF A01.

From Combustion turbine residual oil workshop; Atlanta, GA, USA (17 Jul 1980).

As the result of rising fuel prices many US utilities are interested in the possibility of using cheaper unrefined or residual fuel for their gas turbines; therefore, a survey was conducted of 28 gas turbine owners who were using residual or crude oil to determine their experience with these cheaper fuels. Difficulties or problems encountered with the fuel system, including storage, handling and treatment facilities and in gas turbine operation are described and tabulated. How these difficulties can be avoided or corrected are discussed. (LCL)

28605 (EPRI-WS—80-132, pp 37p, Paper 9) **Petrolite views on residual oil treating.** Greenlee, R.W.; Lucas, R.N. (Petrolite Corp., Webster Groves, MO). May 1981. NTIS, PC A13/MF A01.

From Combustion turbine residual oil workshop; Atlanta, GA, USA (17 Jul 1980).

Heavy oils as combustion turbine fuels are of interest to utility operators because they are usually cheaper and more readily available than distillates. However, the use of heavy fuels in combustion turbines is certain to increase (by 5 to 10%) the capital costs of power generation and will increase the continuing expense associated with turbine operations. Some of these heavy-fuel problems can be solved by the turbine manufacturer through changes in equipment design; remedies for others can best be provided by the combustion turbine operator. Solutions to this latter class of problems relate to fuel treatment and are discussed here. Information is included on: the physical and chemical properties of turbine fuels; heavy oil contaminants; turbine fouling and corrosion; fuel treatment and treatment facilities; water washing, electrostatic washing, and filtration of fuels; and experience with fuel treatment facilities around the world. It is concluded that residual oils as routinely processed with modern fuel treatment technology are technically acceptable for use in most currently available combustion turbines, but the economic viability for the use of these treated fuels has been proven in only a relatively limited number of cases. (LCL)

28606 **Use of additives to reduce ash fouling problems in lignite-fired boilers.** Honea, F.I.; Rindt, D.K.; Middleton, R.; Rothe, D. (US DOE, Grand Forks, ND). *American Society of Mechanical Engineers, [Paper] ;* No. 80-JPGC-Fu-3, vp(1980).

Additives to reduce ash fouling problems in lignite-fired, utility boilers have been evaluated in a research and pilot-scale furnace test program at the Grand Forks Energy Technology Center (GFETC). Compounds which show promise to reduce the ash deposit strength include calcium, magnesium and calcium alumina silicate (melilite) compounds. The Otter Tail Power Company and the Basin Electric Power Cooperative have also tested additives in lignite-fired power plants and have had some success with calcium compounds in pulverized-coal fired boilers. However, cyclone-fired boilers still present a problem and additional additives are being evaluated for these boilers. 8 refs.

28607 **Instrumentation in the power industry,** Volume 23. Good, E.M. (ed.). Research Triangle Park, NC; Instrument Society of America (1980). 178p. (CONF-8005167—).

From 23. ISA power instrumentation symposium; Chicago, IL, USA (14 May 1980).

Eighteen papers were presented at the meeting. A separate abstract was prepared for each paper. (LCL)

28608 **Ash pond water discharge and recycle pump control system philosophy with pH adjustment for a 3160 MW electric generating plant.** Simmons, W.O. (Georgia Power Co., Atlanta); McDonald, C.B.; Tennant, D.V. pp 5-10 of Instrumentation in the power industry, Volume 23. Good, E.M. (ed.). Research Triangle Park, NC; Instrument Society of America (1980).

From 23. ISA power instrumentation symposium; Chicago, IL, USA (14 May 1980).

In dealing with the National Pollutant Discharge Elimination System (NPDES) regulations required to be implemented in 1977, and looking ahead at regulations to take effect in 1984, Georgia Power Company embarked on a program to develop a practical means of compliance. Specifically, in dealing with the requirements conerning discharge of ash sluice water at Plant Bowen, Georgia Power Company decided to install an ash pond discharge neutralization system to meet the 1977 regulations and a recycle system to facilitate meeting the regulations to become effective in 1984. This paper discusses the NPDES design criteria established by Georgia Power Company, the resulting pump station for recycling ash sluice water, the ash pond discharge neutralization system and the associated controls for ash pond level, ash pond discharge neutralization and recylce pumps. While the controls discussed in this paper may not necessarily be the optimum solution, the system met the design criteria and has operated successfully since September 1977.

28609 **Programmable controller application for power plant wastewater treatment facility.** Baker, A.T. (Long Island Lighting Co., Hicksville, NY); Rahoi, R.J. pp 11-17 of Instrumentation in the power industry, Volume 23. Good, E.M. (ed.). Research Triangle Park, NC; Instrument Society of America (1980).

From 23. ISA power instrumentation symposium; Chicago, IL, USA (14 May 1980).

A programmable controller has been installed at three power stations to control the handling of from 500,000 to 2,000,000 gallons of wastewater per day. It provided a solution to the problem of ordering major electrical control equipment long before the systems were designed. Since this was the utility's first application of programmable controllers, their engineers had to decide which system to purchase from the large array of manufacturers available. The training of personnel and development of programmed control systems were the next areas to be considered. The use of a programmable controller in this application proved to be very cost-effective when compared to the standard electromechanical control systems. The engineers are looking into such future additions to the system as equipment performance monitoring, data handling and direct analog inputs.

28610 **Human factor considerations in the design of the man-machine interface for power plant process computers.** Ben-Yaacov, G. (Gibbs and Hill, Inc., Omaha, NE). pp 19-33 of Instrumentation in the power industry, Volume 23. Good, E.M. (ed.). Research Triangle Park, NC; Instrument Society of America (1980).

From 23. ISA power instrumentation symposium; Chicago, IL, USA (14 May 1980).

Various studies have shown the need for a human factors engineering approach to the design of power plant control rooms to promote operator efficiency and to reduce operator error in the operation of the complex systems found in today's power plants. Computer equipment available today can address some of the human factor problems of control room design providing one carefully considers the man-machine interface problems peculiar to this type of equipment. The simplification of the man-machine medium is of prime importance for the efficient, error-free utilization of the computer system which lends to efficient, error-free control of the power plant.

28611 **Multiple analytical measurement strategies for fossil-fuel-fired combustion.** Wood, R.D. (Bendix Environmental and Process Instruments Div., Lewisburg, WV). pp 53-58 of Instrumentation in the power industry, Volume 23. Good, E.M. (ed.). Research Triangle Park, NC; Instrument Society of America (1980).

From 23. ISA power instrumentation symposium; Chicago, IL, USA (14 May 1980).

Obtaining the maximum thermal efficiency in fossil-fuel-fired combustion processes is dependent on operating at the correct air/fuel ratio. To ascertain the optimum technique for setting the air/fuel ratio, a unique experimental program is in progress. This program is centered around an extractive stack sampling system that provides clean, dry sample to various analyzers. The system is described herein, along with progress to date.

28612 **Control strategy for variable pressure once-through units.** Russell, T.D.; Walker, R.R. Sr. (Bailey Controls Co., Wickliffe, OH). pp 59-64 of Instrumentation in the power industry, Volume 23. Good, E.M. (ed.). Research Triangle Park, NC; Instrument Society of America (1980).

From 23. ISA power instrumentation symposium; Chicago, IL, USA (14 May 1980).

The changing technology and size of electrical generating units has created a need for efficient cycling units for peak power. This paper addresses itself to a control strategy proposed for variable pressure once-through boilers, either of subcritical or supercritical design.

28613 **Cycling European power plants using steam bypass stations, sliding pressure mode of operation and thermal stress evaluating equipment.** Supancic, K.H. (Siemens A.G. Karlsruhe, Germany); Jones, A.W. pp 65-71 of Instrumentation in the power industry, Volume 23. Good, E.M. (ed.). Research Triangle Park, NC; Instrument Society of America (1980).

From 23. ISA power instrumentation symposium; Chicago, IL, USA (14 May 1980).

The paper defines the term cycling operation and describes the requirements for both plant and automation in such power plants. Typical solutions for plant and automation concepts are stated and performance figures for such plant configurations are enumerated. Special instruments such as thermal stress evaluators for both steam generator and turbine and their use within the automation concepts are explained.

28614 **SOFPAC: full scale simulation of fossil-fired plant processes and controls for validating and tuning DDC control algorithms.** Kitscha, W.; Kar, P.K.; Chou, Q.B. (Ontario Hydro, Toronto). pp 73-83 of Instrumentation in the power industry, Volume 23. Good, E.M. (ed.). Research Triangle Park, NC; Instrument Society of America (1980).

From 23. ISA power instrumentation symposium; Chicago, IL, USA (14 May 1980).

A computer program SOFPAC for a detailed Simulation of Fossil-fired Power Plant Processes and Controls was developed to investigate the control of a 150 MW lignite fired generating station. A nonlinear mathematical model was developed from first principles using the conservation of mass, momentum and energy. Design data was used to establish model coefficients. The controllers and control logics were programmed to duplicate the DDC control programs to be used at the station. This paper briefly describes the SOFPAC program, the various process models and control algorithms, verification/tuning of control algorithms, simulation results and associated experiences in this simulation study.

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28615 **(ANL/EES-TM—141) Prevention of significant deterioration in air quality: permits for electric utilities, 1975-1980.** Garvey, D.B.; Moser, S.B. (Argonne National Lab., IL (USA)). Oct 1980. Contract W-31-109-ENG-38. 133p. NTIS, PC A07/MF A01. Order Number DE81027145.

A series of federal air quality regulations entitled Prevention of Significant Deterioration (PSD) has established rigid requirements for the siting of new sources of emissions in areas where the ambient air is cleaner than the National Ambient Air Quality Standards (NAAQS). The history of the siting of new fossil-fueled utility boilers since the first promulgation of PSD regulations (December

1974) is reviewed. Regional trends in utility siting are summarized. The following PSD permit information is examined: location, increment consumption and best available control technology (BACT). The constraints that might result from consumption of the Class II 24-h increments for SO_2 are reviewed in detail. The discussion is based on a review of PSD permits for utility boilers (approved, withdrawn, denied, and pending) from the files of the 10 regional offices of the Environmental Protection Agency. The review took place during July and August 1980.

28616 **(DOE/FC/10226—T1) Survey and evaluation of modern electrostatic concepts applied to high-resistivity fly ash.** (Acurex Corp., Mountain View, CA (USA); Acurex Corp., Morrisville, NC (USA). Southeast Regional Office). Dec 1980. Contract AC18-80FC10226. 115p. NTIS, PC A04/MF A01. Order Number DE81026204.

The ineffectiveness of conventional electrostatic precipitators on high resistivity fly ash has different, though interrelated, causes. Voltages high enough to generate corona at the discharge electrode also generate back corona on the deposited dust layer. Removal of the layer results in reentrainment losses. Reduction of voltage to suppress back corona reduces precipitation effectiveness. All of the surveyed concepts attempt to deal with one or more of these problems; most but none will address all of the deficiencies. A versatile multiple-concept pilot precipitator would allow GFETC to develop the optimum combination of novel concepts. Acurex is recommending a precipitator with component interchangeability in three sections: (1) the main precipitator section (one or more cells) should be designed to accept either conventional electrodes or a few tri-electrode configurations. Versatile pulse-charged power supplies will be needed to accommodate the various electrode configurations. The best method of suppressing back-corona in the precipitator itself can thus be developed; (2) a precharger section should be installed ahead of the main precipitator to optimize precharger design; and (3) a downstream collector section would test the effectiveness of concepts which lend themselves to effective collection of low-load, high-resistivity, small particles. These include wet precipitators, fabric filters, and bed filters. The separation of functions will allow more effective particle charging in the first section, collection of most of the particulate without reverse ionization in the main section, and polishing of the remaining fine and reentrained particulate in a suitable downstream collector.

28617 **(EPA—600/9-81-019a) Symposium on flue gas desulfurization: proceedings.** Ayer, F.A. (comp.). (Research Triangle Inst., Research Triangle Park, NC (USA)). Apr 1981. 564p. (CONF-8010105—(Vol.1)). C. Order Number DE81903400.

From Symposium on flue gas desulfurization; Houston, TX, USA (28 Oct 1980).

The symposium on Flue Gas Desulfurization was designed to provide a forum for the exhcange of information, including recent technological and regulatory developments, on the application of flue gas desulfurization to utility and industrial boilers. Volume One of the proceedings contains twenty-one papers, which includes a keynote address on the approaches for control of acid rain. The remaining papers are on forecasts of energy and environmental technologies and economics for the 1980's, research and development plans, and utility applications. All of these papers have abstracts. However, papers from the session on the impact of recent legislation and regulations are not included. Volume Two contains papers from the fifth and sixth sessions on by-product utilization and dry scrubbing.

28618 (EPA—600/9-81-019a, pp 85-109) **SO_2 and NO/sub x/ abatement for coal-fired boiler in Japan.** Ando, J. (Chuo Univ., Tokyo, Japan). Apr 1981. NTIS.

From Symposium on flue gas desulfurization; Houston, TX, USA (28 Oct 1980).

The total capacity of coal-fired utility boilers in Japan, which was only 4300 MW (3.7% of total utility power) in 1979, is expected to increase to 10,000 MW (5.6%) in 1985 and to 22,000 MW (10.0%) in 1990. Most of the boilers will apply FGD by the wet limestone-gypsum process because of its reliability and relatively low cost. To save energy and water, FGD systems with a low pressure drop and small water consumption are preferred. Tests on FGD by a dry carbon process are under way. NO/sub x/ concentrations in flue gases from existing coal-fired boilers have been lowered to 200 to 350 ppM by combustion modification including staged combustion and the use of low-NO/sub x/ burners. For further abatement, selective catalytic reduction (SCR) has started to be applied to several coal-fired boilers. The first full-scale combination system of SCR and FGD was put into operation in April 1980. The plant cost for SCR is about one-third that for FGD. A new combustion technology has also been developed in attempts to lower NO/sub x/ below 100 ppM.

28619 (EPA—600/9-81-019a, pp 116-167) **Recent trends in utility flue gas desulfurization.** Smith, M.P.; Melia, M.T.; Laseke, B.A. Jr.; Kaplan, N. Apr 1981. NTIS.

From Symposium on flue gas desulfurization; Houston, TX, USA (28 Oct 1980).

PEDCo Environmental, Inc. has been monitoring the status of utility flue gas desulfurization (FGD) technology since 1974. Information for this program is obtained by visits to plants having operational FGD systems and through periodic contacts with representatives of utility companies, FGD system and equipment suppliers, system designers, research organizations, and regulatory agencies. This paper summarizes the status of utility FGD technology as of the end of August 1980 and indicates recent trends in both the design and performance of the FGD systems. The discussion of current status includes the number and capacity of operational and planned FGD systems, as well as identification of the systems according to process type, emission control strategy, SO_2 inlet concentration levels, and removal efficiencies. Process design developments and trends are summarized for the major components and subsystems associated with commercial FGD systems. In discussing FGD system performance, composite graphs are included presenting annual system availability data (through June 1980) for low-, medium-, and high-sulfur coal FGD installations. A statistical analysis of the data for the years 1978 and 1980 indicates overall trends in FGD system dependability. Finally, capital and annual cost data (both reported and adjusted) are included for the operational FGD systems and cost model comparisons are made. The current data indicate that 203 FGD systems are either operational, under construction, or planned (as of August 1980), representing a total controlled capacity of about 97,000 MW. Of the 203, 73 systems are operational, representing 27,155 MW of the controlled capacity. The dependability analysis indicates that the overall median availability for these operational systems has increased 1.5%, 16.5% and 50.6% for low-, medium-, and high-sulfur coal FGD installations, respectively, between the years 1978 and 1980.

28620 (EPA—600/9-81-019a, pp 168-171) **Flue gas desulfurization information system.** Apr 1981. NTIS.

From Symposium on flue gas desulfurization; Houston, TX, USA (28 Oct 1980).

The most significant product of EPA's utility FGD survey program is a quarterly summary report generated from a computerized data base known as the Flue Gas Desulfurization Information System (FGDIS). This data base represents the latest development in this program. Design and performance data for both the operational and planned domestic utility FGD systems are stored in the FGDIS. Also stored are data on operational domestic scrubbers for removal of particulate matter and data on operational FGD systems applied to coal-fired utility boilers in Japan. The design data contained in FGDIS encompass the entire emission control system and the power-generating unit to which it is applied. Descriptions include location, standards limiting emissions of SO_2 and particulate matter, power-generating capacity, boiler and stack information, average fuel analyses, and other more general data. Input of design data specific to FGD systems ranges from general information such as process type, system supplier, and initial system startup date to more specific component design information and operating parameters such as absorber type, gas and liquid flow rates, and pressure drop. Also included in the data are descriptions of the methods of solids concentrating and waste disposal, flue gas reheat, and mist elimination, and information on capital costs and annual revenue requirements of FGD systems.

28621 (EPA—600/9-81-019a, pp 173-182) **Department of Energy's flue gas desulfurization research and development program.** Trexler, E.C. (Department of Energy, Washington, DC). Apr 1981. NTIS.

From Symposium on flue gas desulfurization; Houston, TX, USA (28 Oct 1980).

The Department of Energy's flue gas desulfurization (FGD) research and development activities are conducted as part of the Advanced Environmental Control Technology Program (AECT). This new AECT program was initiated in FY 1979 with a goal to identify, research, develop, refine and demonstrate cleanup equipment that will clean flue gas for compliance with existing and anticipated environmental pollution regulations, and equipment that will remove the undesirable components from coal derived gas streams to assure reasonable life for utilization equipment such as gas turbines and fuel cells. The FGD project is divided into two parallel efforts identified by the scheduled completion dates as very near-term (end 1983) and near-term (end 1986). The very near-term effort aims at improving the SO_2 removal efficiency and reducing the waste disposal problems of conventional lime/limestone scrubbers. This is being done in coordination with EPRI and EPA scrubber improvement programs, through private sector scrubber instrumentation and analysis, by tests at TVA and other utility prototype and full-scale scrubber facilities, and by transfer of process improvement information. The near-term effort is aimed at supporting new technology SO_2 removal processes that include nonregenerable (throwaway) and regenerable systems that produce potentially marketable by-products such as sulfur and sulfuric acid. These technologies are, or will be, under experimental tests at Fossil Energy Technology Centers, under prototype testing by DOE and EPRI at TVA and other sites, and under initial commercial use evaluation by DOE at power stations and industrial plants. As these technologies mature, private industry will be encouraged to cost-share development with the Government. Information on progress will be disseminated via reports, symposia, plant visitations, demonstrations and workshops.

28622 (EPA—600/9-81-019a, pp 182-230) **EPRI research results in FGD: 1979 to 1980.** Dalton, S.M.; Dene, C.E.; Rhudy, R.G.; Stewart, D.A. (Electric Power Research Inst., Palo Alto, CA). Apr 1981. NTIS.

From Symposium on flue gas desulfurization; Houston, TX, USA (28 Oct 1980).

EPRI has a research effort of approximately $10M/y in flue gas desulfurization covering engineering evaluations, field testing, bench testing, pilot plants, prototypes and demonstrations. This paper reports selected results from projects on FGD water integration, gypsum crystallization, limestone dissolution, wet stack operation, sulfur production via RESOX, absorption/steam stripping, cyclic reheat and integrated emission control. A brief review of current demonstration plans and program emphasis is also included.

28623 (EPA—600/9-81-019a, pp 233-286) **Test results on adipic acid-enhanced limestone scrubbing at the EPA Shawnee Test Facility: third report.** Burbank, D.A. (Bechtel National, Inc., San Francisco, CA); Wang, S.C.; McKinsey, R.R.; Williams, J.E. Apr 1981. NTIS.

From Symposium on flue gas desulfurization; Houston, TX, USA (28 Oct 1980).

Adipic acid has been demonstrated as a powerful scrubbing additive for enhancing SO_2 removal in lime and limestone wet scrubbing tests both at the EPA/IERL pilot plant at Research Triangle Park, North Carolina, and at the EPA-sponsored Shawnee Test Facility near Paducah, Kentucky. Improved limestone utilization and operating reliability have also been demonstrated. Earlier test results using adipic acid, from July 1978 through October 1979, were reported at the Fifth Symposium on Flue Gas Desulfurization in Las Vegas, Nevada, March 5-8, 1979, and at EPA's Fifth Industry Briefing in Raleigh, North Carolina, December 5, 1979. This is the third report on the recent adipic acid test results at the Shawnee Test Facility from October 1979 through May 1980. The recent tests with adipic acid were conducted only on the venturi/spray tower system. All tests were made with limestone slurry. These included: (1) partial factorial tests to characterize the effects of pH, adipic acid concentration, and other operating parameters on SO_2 removal; (2) single-loop (one-tank) tests without forced oxidation at low pH and high (4000 ppM) adipic acid concentration; (3) tests with a venturi only to determine the limits of SO_2 removal; (4) single-loop forced oxidation tests, with both one tank and two tanks; and (5) bleed stream oxidation tests at low pH and high (4000 ppM) adipic acid concentration. Major efforts during the recent test period were directed toward investigation of the effect of pH on the degradation of adipic acid. It was found that the adipic acid degradation is minimized when the scrubber is operated at low (below 5.0 to 5.1) inlet pH. Forced oxidation and poor limestone utilization tend to increase the degradation.

28624 (EPA—600/9-81-019a, pp 287-310) **Cocurrent scrubber tests: Shawnee Test Facility.** Jackson, S.B. (Tennessee Valley Authority, Muscle Shoals, AL). Apr 1981. NTIS.

From Symposium on flue gas desulfurization; Houston, TX, USA (28 Oct 1980).

Prototype cocurrent limestone scrubber tests were performed at the Shawnee Test Facility. The initial cocurrent prototype tests consistently achieved greater than 90% SO_2 removal while operating with inlet flue gas SO_2 concentrations ranging from 1500 ppM to 3000 ppM. Although the prototype scrubber tower was reliable, total system reliability was not achieved during the initial tests at 27 ft/sec superficial scrubber gas velocity, primarily because of solids deposits in the mist eliminator and the inline, indirect steam reheater. At a 20 ft/sec superficial gas velocity and with low fly ash loading in the inlet flue gas, there were no significant solids deposits in the mist eliminator or reheater. Mist eliminator operation was reliable during operation with high fly ash loadings and a 20 ft/sec superficial gas velocity, but the inline reheater continued to plug with slurry solids. During forced-oxidation tests with a single scrubber hold tank and multiple hold tanks, operating conditions were identified which consistently removed greater than 90% of the SO_2 and oxidized greater than 95% of the calcium sulfite in the scrubber slurry to gypsum.

28625 (EPA—600/9-81-019a, pp 311-325) **Dowa Process Tests: Shawnee Test Facility.** Jackson, S.B. (Tennessee Valley Authority, Muscle Shoals, AL); Dene, C.E.; Smith, D.B. Apr 1981. NTIS.

From Symposium on flue gas desulfurization; Houston, TX, USA (28 Oct 1980).

Dowa dual-alkali process tests at the Shawnee Test Facility were the first application of the Dowa process with flue gas from a coal-fired boiler. The operating conditions were based on operating experience at Dowa facilities at smelter plants, sulfuric acid plants, and oil-fired steam generator plants in Japan. The initial tests utilized the existing Turbulent Contact Absorber (TCA) in the Shawnee train 200. The maximum SO_2 removal efficiency by the TCA was 85% to 90%. During the TCA testing, problems with gas flow distribution in the absorber were observed. Subsequently, the mobile sphere packing in the TCA was replaced with rigid packing to improve gas flow distribution and gas liquid contact. A factorial absorption test series was conducted using the rigid packing. As a result, operating conditions which will consistently achieve greater than 90% SO_2 removal efficiency were identified. Performance of the neutralization and gypsum dewatering process steps was generally satisfactory during the absorption tests. Extensive reliability tests were not conducted; however, no significant reliability problems were identified during the factorial absorption tests.

28626 (EPA—600/9-81-019a, pp 327-345) **FGD experiences.** Hicks, N.D. (City Utilities, Springfield, MO); Hargrove, O.W. Apr 1981. NTIS.

From Symposium on flue gas desulfurization; Houston, TX, USA (28 Oct 1980).

City Utilities of Springfield, Missouri, began commercial operation of the FGD system in September 1977. Two turbulent contact absorber modules are arranged in parallel and utilize a pulverized limestone slurry for SO_2 removal. The scrubbers serve a 195 MW unit with a Riley Stoker boiler burning 3.5% sulfur coal. Station design was by Burns and McDonnell, with the Air Correction Division of Universal Oil Products, Inc. responsible for the FGD system on this new facility. The absorber modules and various support systems have experienced a variety of problems since initial start-up. The more severe problems encountered have been: absorber and demister pluggage; failure of absorber spheres; pipe breakage; control and instrumentation malfunctions; and expansion joint, damper, and duct corrosion. Past and planned efforts to rectify these difficulties, and to improve FGD system reliability, are discussed in detail. A related problem area has been the continuous monitoring systems for flue gas opacity and SO_2 emissions. Original equipment has proven unsuccessful and the investigation toward a

solution, with the aid of a consulting firm, is described. The station is to be the host facility for an EPA sponsored full scale demonstration of adipic acid as an additive to wet limestone FGD systems. Anticipated results are enhanced efficiency and improved operation of the pollution control facility. Also involved in the project is the Radian Corporation and Universal Oil Products, Inc.

28627 (EPA—600/9-81-019a, pp 347-369) **Results of the Chiyoda Thoroughbred-121 prototype evaluation.** Morasky, T.M. (Electric Power Research Inst., Palo Alto, CA); Burford, D.P.; Hargrove, O.W. Apr 1981. NTIS.

From Symposium on flue gas desulfurization; Houston, TX, USA (28 Oct 1980).

A ten-month evaluation of the Chiyoda Thoroughbred 121 Prototype Process (CT-121) was conducted at the Scholz Electric Generating Station of Gulf Power Company. The 23-megawatt CT-121 prototype was modified from existing CT-101 process equipment at Scholz by Chiyoda International Corporation, a subsidiary of Chiyoda Chemical Engineering and Construction Company, Ltd. Chiyoda operated the prototype, and the Electric Power Research Institute and Southern Company sponsored technical evaluations of the prototype process performance. This paper summarizes the findings of these evaluations. Detailed results of the gypsum stacking evaluation will be presented with the Chiyoda Thoroughbred 121 presentation.

28628 (EPA—600/9-81-019a, pp 371-390) **Forced oxidation of limestone scrubber sludge at TVA's Widows Creek Unit 8 Steam Plant.** Massey, C.L.; Moore, N.D.; Munson, G.T.; Runyan, R.A.; Wells, W.L. (Tennessee Valley Authority, Chattanooga). Apr 1981. NTIS.

From Symposium on flue gas desulfurization; Houston, TX, USA (28 Oct 1980).

Tests on one module (140 MW) have been carried out to demonstrate the feasibility of forced oxidation of limestone scrubber sludge to gypsum as a viable technique for ultimate disposal of these waste materials. Both one-tank and two-tank oxidation experiments were studied with data indicating the two-tank runs more closely met test objectives. Equations to predict oxidation were developed and expressed as a function of mass transfer and chemical kinetics. Air stoichiometries of between 1.75 and 2.0 lb atoms 0/lb mole SO_2 absorbed will consistently produce oxidation of ~ 95%. As a result of the Forced Oxidation Test Proram, this method is being given consideration as one of the alternative methods of scrubber sludge disposal for Widows Creek units 7 and 8. Additionally, Paradise Steam Plant units 1 and 2 scrubber trains are being designed with a forced oxidation option to produce a sulfate waste product.

28629 (EPA—600/9-81-019a, pp 391-413) **La Cygne Station Unit No. 1 wet scrubber operating experience.** Spring, R.A. (Kansas City Power and Light Co., KA). Apr 1981. NTIS.

From Symposium on flue gas desulfurization; Houston, TX, USA (28 Oct 1980).

In the late 1960's, Kansas City Power and Light Company and Kansas Gas and Electric Company entered into a joint venture to construct an 800 MW coal fired generating unit. An east central Kansas location was selected for its ample coal reserves and adequate water supply capabilities. The coal reserves proved to be a low grade with an average of 5 1/4% sulfur and 24% ash. To make this coal an acceptable boiler fuel a large scale air quality control system was required. After considerable pilot testing on a smaller generating unit burning similar coal, a venturi - absorber scrubber using limestone as the scrubbing agent was selected. Construction of the La Cygne Station Unit No. 1 started in April 1969 and began commercial operation in June 1973. This paper presents a review of the operating experiences, O and M cost trends, availabilities, modifications, manpower and other supportive data relating to this limestone scrubber system.

28630 (EPA—600/9-81-019a, pp 415-431) **One button operation start-up of the Alabama Electric Cooperative FGD system.** Hutcheson, R. (Alabama Electric Cooperative, Leroy); Johnson, C. Apr 1981. NTIS.

From Symposium on flue gas desulfurization; Houston, TX, USA (28 Oct 1980).

In September of 1978, Alabama Electric Cooperative started up a limestone FGD system for its 255 MW Tombigbee Station Unit No. 2, Leroy, Alabama. Since the start-up, the operating experience of the system has been extremely successful. A sophisticated control system has been provided for the FGD system which permits operation from the control room by means of a single button. Start-up of the FGD system consisted of pushing this button. The unit has been on stream since that time. The FGD system is designed to remove 85% of the SO_2 in the flue gas generator from the combustion of 1.8% coal. Under performance test conditions the absorber gas load and inlet SO_2 content were 20% and 35% respectively greater than design. Despite the greater than design conditions a SO_2 removal efficiency of 94% was achieved. A limestone stoichiometry of 1.01 was obtained, probably the lowest ever achieved in the FGD industry. After a year of operation, the system has exhibited a high degree of reliability. Based upon actual measured hours, the system availability has been 91.6%. The FGD system for Unit No. 3, a duplicate of Unit No. 2, has recently been started up. Preliminary results indicate similar performance to that obtained with Unit No. 2. It is the purpose of this paper to discuss in detail the process chemistry, system description and controls which have permitted the successful operation of this unit.

28631 (EPA—600/9-81-019a, pp 433-451) **Operation and maintenance experience of the world's largest spray tower SO_2 scrubbers.** Hewitt, R.A.; Saleem, A. Apr 1981. NTIS.

From Symposium on flue gas desulfurization; Houston, TX, USA (28 Oct 1980).

The 750 MW Monticello boiler No. 3 of Texas Utilities Services, firing lignite coal, is equipped with three large spray towers, designed by Chemico Air Pollution Control Corporation. Each spray tower is sized to handle over one million cubic feet per minute of flue gas. This flue gas desulfuruzation system uses pulverized limestone slurry for scrubbing and includes a flue gas bypass as well as external steam flue gas reheat system. The FGD system went into operation in mid 1978 and has since logged consistently very high availability as well as high SO_2 removal efficiency. The extreme simplicity of the spray tower system has resulted in only modest increase in the power plant's operating and maintenance staff. A recent inspection of the system revealed no major problems with the tower and duct liners or the tower internals. A few isolated spots on the internal slurry pipes showed wear due to close proximity to the sprays. Failure of the rubber lining on the side mounted agitators and slurry recycle pumps has been the primary source of problems with the system. The experience with this system in general has been very satisfactory and Texas Utilities has purchased two essentially duplicate systems for the Twin Oak Power Station.

28632 (EPA—600/9-81-019a, pp 453-472) **Dual alkali demonstration project interim report.** Van Ness, R.P. (Louisville Gas and Electric Co., KY); Kaplan, N.; Watson, D.A. Apr 1981. NTIS.

From Symposium on flue gas desulfurization; Houston, TX, USA (28 Oct 1980).

This paper will discuss the results of the recently performed acceptance test on the dual alkali system serving Louisville Gas and Electric Company's Cane Run Unit 6 boiler. The acceptance test was conducted to measure the system performance with respect to the guarantees offered Louisville Gas and Electric by Combustion Equipment Associates. The results of the testing were as follows: SO_2 removal averaged 94% and 143 ppM outlet concentration; soda ash consumption averaged 0.042 mole soda ash per mole sulfur dioxide removed; lime consumption averaged 1.04 mole CaO per mole sulfur dioxide removed; power consumption averaged 1.05% of generation; filter cake solids averaged 52.2 wt % insoluble solids; and there was no net particulate matter addition. Various problems attributable to the boiler, the FGD system, and the quality and quantity of the carbide lime supplied to the system delayed the acceptance testing until July 1980. Th year-long demonstration period was officially started in May 1980. The nature of the problems experienced and their solutions are discussed.

28633 (EPA—600/9-81-019a, pp 473-496) **Operating experience with the FMC double alkali process.** Durkin, T.H. (Southern Indiana Gas and Electric Co., Evansville); Van Meter, J.A.; Legatski, L.K. Apr 1981. NTIS.

From Symposium on flue gas desulfurization; Houston, TX, USA (28 Oct 1980).

This paper reviews the design and initial operating experience with the flue gas desulfurization system at Southern Indiana Gas and Electric Company's (SIGECO's) A. B. Brown Station Unit No. 1, a 265 MW steam electric station burning up to 4.5% sulfur coal in a pressurized, pulverized coal boiler. After initial checkout in the spring and summer of 1979, the FGD system began routine continuous operation. Overall operating results for sulfur dioxide collection, chemical consumption, availability, maintenance requirements, and operating costs are presented. The problem areas that contributed significantly to maintenance requirements or non-availability of the system are discussed in detail. Not counting the scheduled outage, the system has enjoyed a 96% availability overall in its first year of operation on a high sulfur coal application. Sulfur dioxide removal of over 90% has been routinely demonstrated. Overall operating costs on an annual revenue requirements basis are close to the original projections.

28634 (EPA—600/9-81-019a, pp 497-542) **Status report on the Wellman-Lord/Allied Chemical flue gas desulfurization plant at Northern Indiana Public Service Company's Dean H. Mitchell Station.** Mann, E.L. (Northern Indiana Public Service Co., Hammond); Adams, R.C. Apr 1981. NTIS.

From Symposium on flue gas desulfurization; Houston, TX, USA (28 Oct 1980).

The Northern Indiana Public Service Company and the US Environmental Protection Agency entered into a cost-shared contract in June of 1972 for the design, construction, and operation of a regenerable flue gas desulfurization (FGD) demonstration plant. The system selected for the project was a combination of the Wellman-Lord SO_2 Recovery Process and the Allied Chemical SO_2 Reduction Process. The FGD plant was to be retrofitted to NIPSCO's 115 MW pulverized coal-fired Unit No. 11 at the Dean H. Mitchell Station in Gary, Indiana. NIPSCO entered into contracts with Davy Powergas, Inc., for the design and construction of the FGD plant and with Allied Chemical Corporation for operation of the plant. The FGD plant acceptance test was successfully completed on September 14, 1977. The plant completed a two-year demonstration test period during which information was collected and reported regarding pollution control performance, secondary effects, economics, and reliability of the system. TRW, Inc., was the independent evaluator for the EPA through October, 1979. A follow-on EPA/NIPSCO contract of seven and one-half months has recently been completed. Operation of the plant continues.

28635 (EPA—600/9-81-019a, pp 543-558) **Magnesium FGD at TVA: pilot and full-scale designs.** Marcus, E.G. (Tennessee Valley Authority, Chattanooga); Wright, T.L.; Wells, W.L. Apr 1981. NTIS.

From Symposium on flue gas desulfurization; Houston, TX, USA (28 Oct 1980).

This paper discusses pilot and full-scale magnesium flue gas desulfurization (FGD) designs by TVA. The full-scale (600-MW equivalent) magnesium FGD design is for operation at high and low load factors for a high sulfur coal. After a process and system chemistry (magnesium sulfite/bisulfite) description, the paper describes the FGD equipment and system operation which includes an onsite acid plant. The second part of the paper discusses information on a test program and schedule of a pilot plant being considered by TVA to verify the magnesium FGD design.

28636 **Current considerations for continuous emission monitoring.** Franczak, D.F.; Paprocki, T.J. (Sargent and Lundy, Chicago, IL). pp 95-105 of Instrumentation in the power industry, Volume 23. Good, E.M. (ed.). Research Triangle Park, NC; Instrument Society of America (1980).

From 23. ISA power instrumentation symposium; Chicago, IL, USA (14 May 1980).

This paper reviews the history of the Clean Air Act and Title 40 of the Code of Federal Regulations Part 60 (40 CFR Part 60) and their impact on electric utilities with regard to the requirements of continuous emission monitoring (CEM) equipment. Structural and mechanical problems associated with the installation of CEM equipment will be described and solutions to current problems with the location of this equipment will be discussed. Throughout the discussions, the CEM equipment will be located at the sites specified in both the current form of 40 CFR Part 60 and the October 10, 1979 proposed revisions of this code which assume a representative sample of sulfur dioxide (SO_2), diluent (CO_2 or O_2), opacity and particulate matter. A typical coal-fired 500 megawatt power plant with a 500 foot tall stack will be used as the subject plant in all discussions. In-situ CEM equipment which is commercially available will be the subject of the discussions dealing with the phases of both laws and the possibility of using extractive equipment pending promulgation of the October 10 revision of 40 CFR Part 60 will also be discussed.

28637 **Design trends in control of flue gas scrubbers.** Bayless, J.W. III. (Black and Veatch, Kansas City, MO). pp 107-126 of Instrumentation in the power industry, Volume 23. Good, E.M. (ed.). Research Triangle Park, NC; Instrument Society of America (1980).

From 23. ISA power instrumentation symposium; Chicago, IL, USA (14 May 1980).

This paper presents some general approaches to Flue Gas Scrubbing (FGS) control system design. An FGS control system currently in operation is described and some advanced systems now under development are discussed. This paper pertains only to FGS control systems used in coal fueled steam-electric generating stations.

28638 **Process control of scrubbers.** Stenby, E.W.; Grimm, R.P.; Hoskins, W.W. (Stearns-Roger Engineering Corp., Denver, CO). pp 127-137 of Instrumentation in the power industry, Volume 23. Good, E.M. (ed.). Research Triangle Park, NC; Instrument Society of America (1980).

From 23. ISA power instrumentation symposium; Chicago, IL, USA (14 May 1980).

An overview is presented of the various types of wet and dry scrubbers that have been either widely applied or are considered to be technologically advanced. Certain of these scrubbing systems will be reviewed for their unique design and operating characteristics, with emphasis applied to the control aspects. All of the scrubber systems have certain common control functions, primarily in the interface with external systems, such as the boiler. External control interactions, as well as control functions within the scrubbing process are discussed. Where possible, adverse operation and problem areas are highlighted.

28639 **Investigation of alkali feedrate automatic control for the slurry process of limestone scrubbers.** Garrett, P. (Univ. of Cincinnati, OH). pp 139-148 of Instrumentation in the power industry, Volume 23. Good, E.M. (ed.). Research Triangle Park, NC; Instrument Society of America (1980).

From 23. ISA power instrumentation symposium; Chicago, IL, USA (14 May 1980).

Three automatic control methods are analyzed for dense limestone feedrate to the recirculating slurry based upon mathematical modeling, simulation studies, and experimental pilot scrubber tests: (1) stoichiometric control which is based on meaningful material balance measurements, but lacking in its visibility of influential slurry factors such as the process gain and flyash alkaline content which can result in significant limestone feedrate errors; (2) slurry pH measurement and control which is responsive to an agglomerate of slurry reactions invisible to stoichiometric control, but requires a rigorous design for stable operation due to the potential interaction of the slurry and control system gain and phase shift elements; and (3) combined stoichiometric and pH control which utilizes the most independent process measurements to determine limestone feedrate, and is optimum in minimizing the disorder of the slurry to load changes or other process upsets.

2003 Power Transmission And Distribution

REFER ALSO TO CITATION(S) 28821

28640 **(BNL—29291) Test results of ac superconducting cables.** Forsyth, E.B. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 8p. (CONF-810903—1). NTIS, PC A02/MF A01.

From IEEE/PES conference; Minneapolis, MN, USA (20 Sep 1981).

All the major components of an ac superconducting power transmission system have been developed. A summary of test results during the developmental stages is given. A Test Facility designed to demonstrate and evaluate cables rated for 138 kV, 1000-MVA 3-phi service is under construction. Most of the equipment has been installed and tested; results are presented.

28641 **(DOE/RA/50156—2) Determination of threshold and maximum operating electric stresses for selected high-voltage insulations. Progress report No. 1, September 1, 1980-May 30, 1981.** Sosnowski, M.; Katz, C. (Cable Technology Labs., Inc., New Brunswick, NJ (USA)). 1981. Contract AC02-80RA50156. 69p. (CTL—81-009). NTIS, PC A04/MF A01. Order Number DE81025967.

Based on the successful completion of an extensive research project to develop a new method for the determination of threshold voltages in XLPE and EPR insulated cables, tests were initiated to establish the maximum safe operating electric stresses of crosslinked polyethylene insulated cables having contaminants in the insulation. The present report covers the preliminary use of a range of sizes and levels of contaminants in the insulation to obtain cables with a range of dielectric breakdown strengths. Based on the preliminary results a selection was made to achieve cables with the range of breakdown strength required for the study. After the selection was completed two sizes of contaminants were selected to manufacture cables with medium and low breakdown strength. High breakdown strength was achieved by using cables without contaminants in the insulation. Using the newly manufactured cables (after subjecting to a thermal treatment) and a test method developed during the previous research project numerous tests were performed and the threshold voltage level of the three cables was determined at room temperature.

28642 **(EPRI-EL—1605-Vol.2) Graphical and tabular results of computer simulation of faulted URD cables. Volume 2: handbook and graphical data.** Joy, E.B.; Meliopoulos, A.P.; Webb, R.P. (Georgia Inst. of Tech., Atlanta (USA). School of Electrical Engineering). Jun 1981. 344p. NTIS, PC A15/MF A01. Order Number DE81903934.

A method for computing shield potentials of underground residential distribution (URD) cable shield potentials is presented. Earth potentials in the vicinity of the buried cable are also computed. The method utilizes a numerical solution of Laplace's equation to account for earth currents, and a modified nodal analysis method to account for conductor and shield currents as well as inductive coupling in the underground cable system. A computer program has been developed capable of analyzing long lengths of URD cable together with existing ground rods, faults, open neutrals, feeding substation, and substation grounds. The system analyzed corresponds to practical URD cable distribution systems. Extensive simulation of various URD cable systems in various soil environments has been performed and the results tabulated. The simulation program employed and the applicable theory is documented in Volume 1 of this report. In Volume 2 of the report, the simulation results are documented in handbook form. From these graphs and tables, touch and step potentials on the earth surface can be determined for various cable types, network connections, and soil types.

28643 **(EPRI-EL—1895) Development of a high-power vacuum interrupter. Final report.** Rich, J.A.; Farrall, G.A.; Imam, I.; Sofianek, J.C. (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). Jun 1981. 382p. NTIS, PC A17/MF A01. Order Number DE81903931.

The goal of the present investigation is to assess the feasibility of designing and building a vacuum interrupter for transmission systems; to specifically develop a vacuum interrupter with a voltage capability in the 72-80 kV range and a current capability in the 63-80 kA range with a continuous current rating of 3000 A. To implement this undertaking, analytical and experimental work was carried out in four major problem areas: arc physics; vacuum breakdown; mechanical problems; interrupter fabrication and test. The leading concept is that of the diffuse vacuum arc, particularly as embodied in electrode structures of rod array type; structures which are capable of carrying very large arcing currents without suffering damage. Corollary to the diffuse arc concept is that of arc transfer from the butt contacts to the fixed-gap diffuse arc structure and the separation of functions which this allows. The original intent was to build four sealed interrupters each of a separate and distinct design, the fourth to be the prototype. Three interrupters were actually built, with records of performance ranging from poor to outstanding. The must successful interrupter was a triggered vacuum gap of rod array type whose interruption performance represents a high watermark for interruption in vacuum viz. 63 kA, 97 kV rated voltage (84 kV test voltage). Actually, the current and voltage limitations are not known since the tube was not tested to failure. A possible application for the interrupter is as a very fast, high-voltage, high current crowbar switch for protecting power transmission equipment and circuits. The single major problem blocking progress to the prototype is that of arc transfer. Though rapid and efficient transfer has been demonstrated in the laboratory on demountable systems, a successful translation to a sealed vacuum interrupter has not been achieved.

28644 **(EPRI-EL—1947) Development of a vacuum arc fault current limiter.** Dollinger, R.; Gilmour, A.S. Jr. (State Univ. of New York, Buffalo (USA). Dept. of Electrical Engineering). Jul 1981. 104p. NTIS, PC A06/MF A01. Order Number DE81903927.

The primary purpose of this program was to develop an understanding of the operating principles of the vacuum arc devices under development at the State University of New York at Buffalo for fault current limiting applications. The general operating characteristics are given for two basic vacuum arc devices. One is the Vacuum Arc Fault Current Limiter and the other is the Magnetically Controlled Vacuum Arc Switch. The results of detailed studies of the phenomena occurring with the two devices are described. In particular, the repetitive voltage spiking phenomena that occurs in the Vacuum Arc Fault Current Limiter is treated in substantial detail. The mechanism of the voltage spiking (the repetitive formation and collapse of an anode sheath) is described along with measurements that were made of parameters associated with repetitive spiking. Techniques for enhancing current limiting by enhancing spiking development are discussed. Work on the magnetically controlled vacuum arc switch and the cooperative efforts with the industrial partner (Gould-Brown Boveri) are described.

28645 **(EPRI-EL—1960-Vol.1) Human-factors review of electric-power-dispatch control centers. Volume 1. Survey results summary. Interim report.** Seidenstein, S.; Williams, A.R.; Goddard, C.J.; Chesney, M. (Lockheed Missiles and Space Co., Sunnyvale, CA (USA)). Jul 1981. 82p. NTIS, PC A05/MF A01. Order Number DE81903930.

Human factors is a systems-oriented interdisciplinary specialty concerned with influencing the design of systems, equipment, facilities, and operational environments to promote effective system operations through emphasis on efficient and reliable operator performance. Phase I of this project evaluated a sample of 13 contemporary electric power control centers by conducting site surveys; these surveys included checklists, guided interviews, photography, direct physical measurement, and technical discussions with operators, management, and supervisory personnel at each site. The project evaluated the information available to the operator and the physical interface between the operator and power systems, as well as the operational setting in which tasks are performed. Guidelines for the application of human factors principles are given where applicable. Particular attention was given to the design of the cathode-ray tube (CRT) interface, the data base, facility lighting, training, manning, and work stress. Several potential areas for further study are identified. Volume 1 is a summary report of the findings of the dispatch control center human factors survey.

28646 **(EPRI-EL—1960-Vol.2) Human-factors review of electric-power-dispatch control centers. Volume 2. Detailed survey results. Interim report.** Seidenstein, S.; Williams, A.R.; Goddard, C.J.; Chesney, M. (Lockheed Missiles and Space Co., Sunnyvale, CA (USA)). Jul 1981. 417p. NTIS, PC A18/MF A01. Order Number DE81903928.

Human factors is a systems-oriented interdisciplinary specialty concerned with influencing the design of systems, equipment,

facilities, and operational environments to promote effective system operations through emphasis on efficient and reliable operator performance. Phase I of this project evaluated a sample of 13 contemporary electric power control centers by conducting the site surveys; these surveys used checklists, guided interviews, photography, direct physical measurement, and technical discussions with 48 operators, management, and supervisory personnel at each site. The project evaluates the information available or used and the physical interfaces between the operator and power systems, as well as the operational setting in which tasks are performed. Guidelines for the application of human factors principles are given where applicable. Particular attention has been given to the design of the cathode-ray tube (CRT) interface, the data base, facility lighting, training, manning, and work stress. Several potential areas for further study are identified. Volume 2 is the detailed report of the findings of the dispatch control center human factors survey.

21 NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 28822

28647 **(CONF-810667—1) Taxonomy of the nuclear plant operator's role.** Kisner, R.A.; Fullerton, A.M.; Frey, P.R.; Dougherty, E.M. (Oak Ridge National Lab., TN (USA); Technology for Energy Corp., Knoxville, TN (USA)). 1981. Contract W-7405-ENG-26. 13p. NTIS, PC A02/MF A01. Order Number DE81023194.

From Enlarged halden programme group meeting on process computer applications; Fredrikstad, Norway (14 Jun 1981).

A program is presently under way at the Oak Ridge National Laboratory (ORNL) to define the functional design requirements of operational aids for nuclear power plant operators. A first and important step in defining these requirements is to develop an understanding of the operator's role or function. This paper describes a taxonomy of operator functions that applies during all operational modes and conditions of the plant. Other topics such as the influence of automation, role acceptance, and the operator's role during emergencies are also discussed. This systematic approach has revealed several areas which have potential for improving the operator's ability to perform his role.

28648 **Increasing importance of a management outlook for engineers with management responsibilities.** Scarola, J.A. (Ebasco Services, Inc., Chicago, IL). pp 165-169 of Instrumentation in the power industry, Volume 23. Good, E.M. (ed.). Research Triangle Park, NC; Instrument Society of America (1980).

From 23. ISA power instrumentation symposium; Chicago, IL, USA (14 May 1980).

The role of engineers in the management of nuclear power plants and the planning for electric utilities is analyzed.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 28250, 28318, 28706, 28716, 28733, 28734, 28738, 28739

28649 **(CONF-810606—79) Fuel utilization in a progressive conversion reactor (PCR).** Leyse, C.F.; Judd, J.L. (Idaho National Engineering Lab., Idaho Falls (USA)). May 1981. Contract AC07-76ID01570. 26p. NTIS, PC A03/MF A01. Order Number DE81027222.

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

Preliminary studies indicate that for once-through fuel cycles, the PCR offers potential improvements over current LWRs in the following major areas: improved uranium utilization (reduced uranium demand), degraded plutonium product in spent fuel, reduced plutonium content of spent fuel, reduced amount of spent fuel, reduced fissile content of spent fuel, and reduced separative work.

28650 **(DOE/ET/34215—15) Fuel performance improvement program. The development of graphite-coated cladding for improved PCI performance of LWR fuels.** Bunnell, L.R.; Welty, R.K. (Battelle Pacific Northwest Labs., Richland, WA (USA); Exxon Nuclear Co., Inc., Richland, WA (USA)). Jun 1981. Contract AC06-76RL01830. 42p. (PNL—3541). NTIS, PC A03/MF A01. Order Number DE81028270.

One of the fuel concepts being tested and demonstrated as part of the Fuel Performance Improvement Program includes a graphite coating applied to the inner surface of the Zircaloy cladding. The technology for producing acceptable coatings was developed starting with the selection of a suitable graphite and culminating with the coating of 200 cladding tubes for demonstration irradiations in the Big Rock Point Reactor. During the process development, methods for controlling the coating thickness and minimizing its hydrogen content were developed that were compatible with production scale operation. During the same period, the graphite coatings were characterized and their properties were determined, mainly to provide information needed for fuel design and licensing considerations. Purity, structure, coating-to-cladding compatibility, thermal conductivity, and friction/wear characteristics were measured.

28651 **(GEAP—24248) Flow-induced vibration for light-water reactors. Progress report, April 1978-December 1979.** Schardt, J.F. (General Electric Co., San Jose, CA (USA). Nuclear Engineering Div.). Mar 1980. Contract AC02-77ET34209. 192p. NTIS, PC A09/MF A01. Order Number DE81025566.

Flow-Induced vibration for Light Water Reactors (FIV for LWRs) is a four-year program designed to improve the FIV performance of light water reactors through the development of design criteria, analytical models for predicting behavior of components, general scaling laws to improve the accuracy of reduced-scale tests, and the identification of high FIV risk areas. The program commenced December 1, 1976, but was suspended on September 30, 1978, due to a shift in Department of Energy (DOE) priorities away from LWR productivity/availability. It was reinitiated as of August 1, 1979. This progress report summarizes the accomplishments achieved during the period from April 1978 to December 1979.

28652 **(ANL-Trans—1196) Thermodynamic contribution to the understanding of the multicomponent system uranium dioxide - fission products - zircaloy.** Kohli, R. (Argonne National Lab., IL (USA)). Jun 1981. Translation of SGAE Report No. 3014, ME-153/78, Austrian Study for Atomic Energy, Institute for Metallurgy, Seibersdorf Research Center. 74p. NTIS, PC A04/MF A01. Order Number DE81025135.

Equilibrium thermodynamic calculations were performed in the UO_2-Fission Products-Zry System under LWR conditions. The oxygen potential gradient of the fuel sets the chemical states of the fission products. Inspection of the standard free energies of the fission product oxides suggests that the rare earths, Zr, Y, Ba and Sr will exist as oxides; the low-melting elements and the platinum metals remain unoxidized; and Mo, Cs, Rb and Tc form oxides only at higher oxygen potentials. Iodine and bromine will be tied up as CsI and CsBr, but the fate of Se and Te cannot be predicted for lack of thermodynamic data. Based on this information and their relative volatilities, detailed thermodynamic calculations were made of the possible reactions of the volatile fission products. Several of these phases are predominant and could be potentially aggressive towards zircaloy.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 28224, 28250, 28318, 28650, 28651, 28652,

28678, 28703, 28704, 28707, 28716, 28722, 28724, 28725, 28726, 28727, 28735, 28736, 28738

28653 (CONF-801038—(Vol.2), pp 1347-1353) **Unique approach to carbon sampling.** Whitney, D.D. (Sacramento Municipal Utility District, CA); Edwards, J.R. Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

To comply with Nuclear Power Plant Standard Technical Specifications, operating nuclear power plants are required to verify that the radioiodine removal efficiency of installed adsorber beds meets or exceeds acceptance criteria every 720 hours of adsorber bed operation. Anytime the integrity of the adsorber bank is violated as a result of maintenance, or testing, an in-place bank bypass-leakage efficiency test is required. Such testing is time consuming and expensive, hence, Rancho Seco has devised a charcoal test tray which exposes adsorber samples to the bed environment and allows sampling without the necessity for violating the integrity of the filter bank.

28654 **(WCAP—9839) Surry unit 2 end of cycle 4 onsite fuel examination: reduced data and operating history.** Balfour, M.G.; Schmidt, G.R.; Muenks, M.F.; Isaac, P.G.; Eng, G.H. (Virginia Electric and Power Co., Richmond (USA); Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Energy Systems Div.). Feb 1981. Contract AC02-79ET34014. 52p. NTIS, PC A04/MF A01. Order Number DE81025750.

Onsite nondestructive examinations were performed at the end of reactor cycle 4 on 17 x 17 demonstration assemblies irradiated in the Surry Unit 2 reactor during cycles 2, 3, and 4. Two three-cycle 17 x 17 demonstration fuel assemblies, four two-cycle 17 x 17 removable fuel rods, and eight three-cycle 17 x 17 removable fuel rods were examined. These examinations included television visual examinations and grid cell friction force measurements performed on the fuel assemblies and breakaway/withdrawal force measurements, television visual examinations, and profilometry measurements performed on the removable fuel rods. The actual reduced onsite data from the breakaway/withdrawal force measurements, the grid cell friction force measurements, and the profilometry measurements are contained in this report.

28655 **Water level measurement and control in large boilers and pressurized water reactors.** Baker, C. (Sensors and Systems Limited, Derby, England). pp 85-93 of Instrumentation in the power industry, Volume 23. Good, E.M. (ed.). Research Triangle Park, NC; Instrument Society of America (1980).

From 23. ISA power instrumentation symposium; Chicago, IL, USA (14 May 1980).

One of the most important parameters in the operation of any sub-critical steam generating boiler plant is the water level in the boiler drum. A low water level will cause loss of flow to the boiler water tubes, causing over-heating and subsequent failure. On the other hand, a high water level will cause water carry-over into the boiler super-heaters and possibly into the associated turbine plant, causing severe thermal stressing problems and possibly catastrophic failure within the boiler or the turbine. In the case of pressurized water reactor type nuclear power stations, accurate level measurement of the water within the pressurizer vessel is of extreme importance and the accuracy required cannot be achieved without some form of Density Compensation applied. The unit described is designed for cold column operation thus avoiding the possible danger of flashing off of the water during transient decreases in ambient pressures.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 28199, 28682, 28683, 28684, 28686, 28687, 28688, 28689, 28690, 28691, 28692, 28720

28656 **(DOE/ER/02712—8) Studies of mechanical properties and irradiation damage nucleation of HTGR graphites. Final report.** Thrower, P.A. (Pennsylvania State Univ., University Park (USA)). May 1981. Contract AS02-76ER02712. 34p. (COO—2712-8). NTIS, PC A03/MF A01. Order Number DE81025639.

Since the submission of the last report (COO-2712-6) work has concentrated on the examination of the effects of oxidation on the compressive strengths of graphites doped with iron, vanadium and calcium. The purpose of the investigation was to determine the relative effects of the impurities on the rates of oxidation in air, CO_2 and H_2O and the resultant reduction in compressive strength.

28657 **(GA-A—15940) Capsule HRB-15B postirradiation examination report.** Ketterer, J.W.; Bullock, R.E. (General Atomic Co., San Diego, CA (USA)). Jun 1981. Contract AT03-76ET35300. 155p. NTIS, PC A08/MF A01. Order Number DE81028590.

Capsule HRB-15B design tested 184 thin graphite trays containing unbonded fuel particles to peak exposures of 6.6×10^{25} n/m^2 ($E > 29$ fJ)/sub HTGR/ fast fluence, ~ 27% fissions per initial metal atom (FIMA) fissile burnup, and 6% FIMA fertile burnup at nominal time-averaged temperatures of 815 to 915°C. The capsule tested a variety of low-enriched uranium (~ 19.5% U-235) fissile particle types, including UC_2, UC/sub x/O/sub y/, UO_2, zirconium-buffered UO_2 (referred to in this report as UO_2/sup *), and 1:1(Th,U)O_2 with both TRISO and silicon-BISO coatings. All fertile particles were ThO_2 with BISO, silicon-BISO, or TRISO coatings. The findings indicated that all TRISO particles retained virtually all of their fission product inventories, except small quantities of silver, at these irradiation temperatures, while some of the silicon-BISO particles released significant amounts of both silver and cesium. No kernel migration, pressure vessel, or outer pyrolytic carbon (OPyC) failures were observed in the fuel particles, which had total diameters of < 900 μm; however, the incidence of failed OPyC coatings was found to increase with particle size in the TRISO inert particles, which had diameters of 1000 to 1200 μm. UO_2/sup */ particles exhibited no detrimental irradiation effects, but they contained pure carbon precipitates in the kernels after irradiation which were not observed in the undoped UO_2 particles. Postirradiation examination revealed no differences in the irradiation performance of three UC/sub x/O/sub y/ kernel types with varying oxygen/uranium ratios.

28658 **(GA-A—16222) KUGEL: a thermal, hydraulic, fuel performance, and gaseous fission product release code for pebble bed reactor core analysis.** Shamasundar, B.I.; Fehrenbach, M.E. (General Atomic Co., San Diego, CA (USA)). May 1981. Contract AT03-76ET35300. 273p. NTIS, PC A13/MF A01. Order Number DE81026561.

The KUGEL computer code is designed to perform thermal/hydraulic analysis and coated-fuel particle performance calculations for axisymmetric pebble bed reactor (PBR) cores. This computer code was developed as part of a Department of Energy (DOE)-funded study designed to verify the published core performance data on PBRs. The KUGEL code is designed to interface directly with the 2DB code, a two-dimensional neutron diffusion code, to obtain distributions of thermal power, fission rate, fuel burnup, and fast neutron fluence, which are needed for thermal/hydraulic and fuel performance calculations. The code is variably dimensioned so that problem size can be easily varied. An interpolation routine allows variable mesh size to be used between the 2DB output and the two-dimensional thermal/hydraulic calculations.

28659 **(GA-A—16339) HTGR Plant Technology Program. Semiannual report for the period ending March 31, 1981.** (General Atomic Co., San Diego, CA (USA)). Jun 1981. Contract AT03-76ET35301. 179p. NTIS, PC A09/MF A01. Order Number DE81028589.

This document reports the technical accomplishments on the HTGR Plant Technology Program at General Atomic during the first half of FY-81. It covers a period when the design direction of the National HTGR Program is being redirected to support a steam cycle cogeneration plant with a lesser but continuing emphasis on higher-temperature applications.

28660 (GA-C—15212-5/79) HTGR Steam Cycle Program. Status report. (General Atomic Co., San Diego, CA (USA)). May 1979. Contract AT03-76ET35301. 15p. NTIS, PC A02/MF A01. Order Number DE81026644.

The objective of the HTGR Steam Cycle Program is to implement a program leading to the commercialization of the HTGR Steam Cycle. This includes design, licensing, development, fabrication, and construction of a HTGR Steam Cycle plant that meets the utility users' needs and requirements, meets the nation's need for reliable and economical electricity generation, and is consistent with the government's non-proliferation and efficient resource utilization policies.

28661 (GA-C—15212-6/79) HTGR steam-cycle program status report. (General Atomic Co., San Diego, CA (USA)). Jun 1979. Contract AT03-76ET35301. 16p. NTIS, PC A02/MF A01. Order Number DE81026620.

The objective of the HTGR Steam Cycle Program is to implement a program leading to the commercialization of the HTGR Steam Cycle. This includes design, licensing, development, fabrication, and construction of a HTGR Steam Cycle plant that meets the utility users' needs and requirements, meets the nation's need for reliable and economical electricity generation, and is consistent with the government's non-proliferation and efficient resource utilization policies. In response to a DOE management recommendation to redirect the overall HTGR Program to advanced HTGR systems, the HTGR-SC Program planning was modified. In the near term, the primary objective of the HTGR-SC Program will be to perform work that materially supports the SC Program but which, at the same time, would be logical if future emphasis is directed to the advanced HTGR's. Top priority is the preparation of a Conceptual Design and Status Report, thus providing a basis for future design work if the HTGR-SC Program is subsequently continued.

28662 HTGR-GT and electrical load integrated control. Chan, T.; Openshaw, F.; Pfremmer, D. (Gen At Co, San Diego, Calif). *American Society of Mechanical Engineers, [Paper]* ; No. 80-WA/DSC-25, vp(1980).

A discussion of the control and operation of the HTGR-GT power plant is presented in terms of its closely coupled electrical load and core cooling functions. The system and its controls are briefly described and comparisons are made with more conventional plants. The results of analyses of selected transients are presented to illustrate the operation and control of the HTGR-GT. The events presented were specifically chosen to show the controllability of the plant and to highlight some of the unique characteristics inherent in this multiloop closed-cycle plant. 10 refs.

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

REFER ALSO TO CITATION(S) 28607, 28716, 28723

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 28201, 28701, 28716, 28729, 28730, 28737, 29127

28663 (CONF-810625—21) Effect of irradiation induced structural material deformations on core restraint design. Kalinowski, J.E. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). 1981. Contract AC15-76CL02395. 27p. NTIS, PC A03/MF A01. Order Number DE81027370.

From ASME PVP conference; Denver, CO, USA (21 Jun 1981).

A summary of the major considerations in the design of LMFBR core restraint systems is presented. A discussion of these considerations is given using the design features and environment of the Clinch River Breeder Reactor Plant core restraint system design. A comparison of core restraint performance with an alternate concept is provided. Conclusions are drawn on the direction of current and future core restraint system designs.

28664 (CONF-810801—48) Alignment and operability analysis of a vertical sodium pump. Gupta, V.K.; Fair, C.E. (Borg-Warner Corp., Carson, CA (USA). Byron Jackson Pump Div.). 1981. Contract AT03-76SF98001. 10p. NTIS, PC A02/MF A01.

From 6. international conference on structural mechanics in reactor technology; Paris, France (17 Aug 1981).

With the objective of identifying important alignment features of pumps such as FFTF, HALLAM, EBR II, PNC, PHENIX, and CRBR, alignment of the vertical sodium pump for the Clinch River Breeder Reactor Plant (CRBRP) is investigated. The CRBRP pump includes a flexibly coupled pump shaft and motor shaft, two oil-film tilting-pad hydrodynamic radial bearings in the motor plus a vertical thrust bearing, and two sodium hydrostatic bearings straddling the double-suction centrifugal impeller in the pump.

28665 (CONF-8008111—2) LMFBR operational and experimental local-fault experience, primarily with oxide fuel elements. Warinner, D.K. (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG-38. 12p. NTIS, PC A02/MF A01. Order Number DE81023137.

From Nuclear engineering conference; San Francisco, CA, USA (18 Aug 1980).

Case-by-case reviews of selective world experience with severe local faults, particularly fuel failure and fuel degradation, are reviewed for two sodium-cooled thermal reactors, several LMFBRs, and LMFBR-fuels experiments. The review summarizes fuel-failure frequency and illustrates the results of the most damaging LMFBR local-fault experiences of the last 20 years beginning with BR-5 and including DFR, BOR-60, BR2's MFBS- and Mol-loops experiments, Fermi, KNK, Rapsodie, EBR-II, and TREAT-D2. Local-fault accommodation is demonstrated and a need to more thoroughly investigate delayed-neutron and gaseous-fission-product signals is highlighted in view of uranate formation, observed blockages, and slow fuel-element failure-propagation.

28666 (DOE/SF/10510—T7) Gas-cooled fast reactor (GCFR) program review committee (PRC). Report No. 13 to members of Helium Breeder Associates (HBA), May 1979 - February 1980. (Helium Breeder Associates, San Diego, CA (USA)). 20 Jun 1980. Contract AC03-79SF10510. 103p. NTIS, PC A06/MF A01.

The responsiveness of the GCFR program structure to changes in design, schedule, and safety issues caused by the decisions to adopt the three-loop over the two-loop primary cooling loop design, to use upflow cooling, and to enhance the natural convection cooling of the plant in a shutdown mode was excellent. The PRC now feels that the criteria for design of a demonstration plant will be manageable and safe. Because of effort to resolve past issues, the PRC has not requested a cost breakdown at this time. It is felt that the HBA effort is properly directed in lieu of the current political malaise regarding future energy supplies and the breeder program in particular. The GCFR is responsive to change and could provide a commercial GCFR before the year 2000.

28667 (DOE/SF/70010—T29) FWC PBT steam generator large leak-test internals: Report ND-74-22. Bosch, R.; Whelley, J. (Foster Wheeler Corp., Livingston, NJ (USA). Nuclear Dept.). 12 Jul 1974. Contract AT03-76SF70010. 17p. NTIS, PC A02/MF A01. Order Number DE81024298.

An LLTI design prototypical of the FWC Protected Bayonet Tube (PBT) steam generator bundle has been prepared. This LLTI is intended for installation in a Large Leak Test Vessel (LLTV) for the purpose of conducting a series of nonreactive pressure tests and Sodium/Water Reaction (SWR) tests. The design, structural analysis, thermal hydraulic analysis, and a description of manufacture for the LLTI are described.

28668 (DOE/SF/70010—T30) State-of-the-art surveys on sodium-water reaction products cleanup methods and equipment. Anand, R.K. (General Electric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.). Jan 1975. Contract AT03-76SF70010. 61p. NTIS, PC A04/MF A01. Order Number DE81024299.

This report describes the basic cleaning methods and equipment which have been used to clean and requalify specimens and

components that have been exposed to sodium. Data obtained from laboratory cleaning of test specimens which were earlier exposed to sodium, have been included for various sodium removal methods. Development programs on cleanup methods for removing sodium-water reaction products along with sodium from surfaces and the purification of Intermediate Heat Transport System (IHTS) sodium after emergency dump have been identified.

28669 **(DOE/SF/76026—T14) Characterization of debris from steam-generator fabrication.** Eichelberger, R.L. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). 1980. Contract AT03-76SF76026. 20p. NTIS, PC A02/MF A01. Order Number DE81025241.

Three different types of residual debris - radiac dust, band saw chips, and fuzzies - were studied (appearance, shape, color, composition, etc.). Debris samples were subjected to simulated manufacturing processes and testing (HYDRO) and operating environments (molten sodium). Scanning electron microscope photographs depicting debris appearance at various stages during the experiment are presented. Conclusions from the tests are: debris rusts when air and moisture are present; rust formation causes debris particles to form aggregates which require mechanical force to separate. Exclusion of air in heat treating reduces rusting. Sodium reduces the iron oxides, causing some disintegration of the particles.

28670 **(GEAP—14059) Report on steam-generator concept development.** Scott, W.B. (comp.). (General Electric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.). Jun 1975. Contract AT03-76SF70010. 86p. (TK—10F-153-75-6). NTIS, PC A05/MF A01. Order Number DE81026538.

This report presents a summary of the conceptual design work on commercial steam generators by the General Electric Company for the ERDA Steam Generator Development Program. Three conceptual steam generator designs are included and discussed in some detail; the Hockey Stick, the J-Module and the Straigth Tube with Expansion Bellows, all referenced to a 1500 MWe 4 loop commercial LMFBR design. Single and double tube concept development is summarized and the effect of each upon steam generator reliability and plant availability is discussed. Double and single tubesheet concepts are discussed and possible ways of introducing leak detection systems for increased reliability are presented. A conceptual design of a Hockey Stick evaporator, for use in a 1200 MWe LMFBR, using double tubes and double tubesheets with a leak detection system is presented and discussed.

28671 **(HEDL—6929) DAFS contribution: the influence of dislocation density and radiation on carbon activity and phase development in AISI 316.** Garner, F.A.; Wolfer, W.G. (Hanford Engineering Development Lab., Richland, WA (USA)). 1980. Contract AC14-76FF02170. 16p. NTIS, PC A02/MF A01. Order Number DE81026492.

The objective of this effort is to identify the role of each major element in the microchemical evolution of AISI 316 and the dependence of that role on preirradiation treatment and parameters such as neutron energy and flux, temperature and stress.

28672 **(HEDL-SA—2321-FP) Fuels and materials for LMFBR's.** Cox, C.M.; Jackson, R.J.; Straalsund, J.L. (Hanford Engineering Development Lab., Richland, WA (USA)). 1981. Contract AC14-76FF02170. 55p. (CONF-810606—65). NTIS, PC A04/MF A01. Order Number DE81024101.

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

This paper reviews development of fuels and materials for the Liquid Metal Fast Breeder Reactor. Included are the status of fuels and materials technology for the LMFBR core components. Design characteristics of FFTF fuel pins and control rods are presented. Sizes of various LMFBR fuel assemblies are compared. The Clinch River Breeder Reactor fuel assembly is nearly identical to that of FFTF except for an increased length to accommodate UO_2 axial blankets within the fuel pins. The DP-1 design is for a large breeder reactor and uses larger ducts and more fuel pins per assembly. By comparison, the fuel assemblies for EBR-II, are much smaller, as is the EBR-II core.

28673 **(ORNL/Sub—78/33830/1) Production circulator fabrication and testing for core flow test loop. Final report, Phase III.** (Oak Ridge National Lab., TN (USA); Mechanical Technology, Inc., Latham, NY (USA)). May 1981. Contract W-7405-ENG-26. 361p. (MTI—81TR39). NTIS, PC A16/MF A01. Order Number DE81028101.

The performance testing of two production helium circulators utilizing gas film lubrication is described. These two centrifugal-type circulators plus an identical circulator prototype will be arranged in series to provide the helium flow requirements for the Core Flow Test Loop which is part of the Gas-Cooled Fast Breeder Reactor Program (GCFR) at the Oak Ridge National Laboratory. This report presents the results of the Phase III performance and supplemental tests, which were carried out by MTI during the period of December 18, 1980 through March 19, 1981. Specific test procedures are outlined and described, as are individual tests for measuring the performance of the circulators. Test data and run descriptions are presented.

28674 **(ORNL/TM—7794) Development of a wide range vortex shedding flowmeter for high temperature helium gas.** Baker, S.P.; Ennis, R.M. Jr.; Herndon, P.G. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 53p. NTIS, PC A04/MF A01. Order Number DE81027441.

A flowmeter was required to measure recirculating helium gas flow over a wide range of conditions in a gas-cooled fast reactor (GCFR) core flow simulator, the ORNL Core Flow Test Loop (CFTL). The flow measurement requirements of the CFTL exceeded the proven performance of any single conventional flowmeter. Therefore, a special purpose vortex shedding flowmeter (VSFM) was developed. A single flowmeter capable of meeting all the CFTL requirements would provide significant economic and performance advantages in the operation of the loop. The development, conceptual design, and final design of a modified VSFM are described. The results of extensive flow calibration of the flowmeter at the Colorado Engineering Experiment Station (CEES) are presented. The report closes with recommendations for application of the VSFM to the CFTL and for future development work.

28675 **(DOE/SF/70030—T25) Electromagnetic pumps for the primary loops of fast-neutron reactors.** Andreev, A.M.; Bezgachev, E.A.; Karasev, B.G.; Kirillov, I.R.; Ogorodnikov, A.P.; Semikov, G.T. (General Electric Co., Sunnyvale, CA (USA)). Nov 1978. Translation of Preprint A-0340. 38p. NTIS, PC A03/MF A01.

A review is presented of works on the status of development of electromagnetic pumps for the primary loops of large nuclear powerplants with fast-neutron reactors. Results are presented from design work on a cylindrical pump which operates at a pressure 9 x 10^5 Pa with a sodium discharge of 15,500 m^3/h, and the device is described. Three versions of the pump are compared, differing in the method of cooling of the winding: with water, Na-K, and nitrogen. Problems of the selection of design and insulation materials, problems of cavitation and power supply of the pump in the emergency cooling mode are discussed.

28676 **(HEDL—6782) RTNS-II irradiation program.** Doran, D.G.; Panayotou, N.F. (Hanford Engineering Development Lab., Richland, WA (USA)). [nd]. Contract AC14-76FF02170. 9p. NTIS, PC A02/MF A01. Order Number DE81026493.

The objective of this work is to determine the effects of high energy neutrons on damage production and evolution, and the relationships of these effects to effects produced by fission reactor neutrons. Specific objectives of current work are the planning and performance of an irradiation program at the Rotating Target Neutron Source (RTNS)-II at the Lawrence Livermore Laboratory (LLL) and postirradiation testing.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

28677 **(LA-UR—81-1025) Heat-pipe development for the SPAR space-power system.** Ranken, W.A. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 15p. (CONF-810902—2). NTIS, PC A02/MF A01.

From Heat pipe conference; London, UK (7 Sep 1981).

The SPAR space power system design is based on a high temperature fast spectrum nuclear reactor that furnishes heat to a thermoelectric conversion system to generate an electrical power output of 100 kW/sub (e)/. An important feature of this design is the use of alkali metal heat pipes to provide redundant, reliable, and low-loss heat transfer at high temperature. Three sets of heat pipes are used in the system. These include sodium/molybdenum heat pipes to transfer heat from the reactor core to the conversion system, potassium/niobium heat pipes to couple the conversion system to the radiator in a redundant manner, and potassium/titanium heat pipes to distribute rejected heat throughout the radiator surface. The designs of these units are discussed and fabrication methods and testing results are described. 12 figures.

2107 Regulation And Licensing

28678 **(CEND—381) Licensing assessment of PWR extended-burnup fuel cycles. Final report.** (Combustion Engineering, Inc., Windsor, CT (USA)). Mar 1981. Contract AT02-76CH91005. 341p. NTIS, PC A15/MF A01. Order Number DE81027275.

The assessment summarized in this report was directed toward identifying additional information which may be required to support the licensing of extended-burnup fuel, but which may not be available from existing research, development, and demonstration (RD and D) programs. This licensing assessment constituted a dry run through the licensing process without performing the detailed analytical calculations necessary to apply for a reload fuel license amendment. The work presented in this report consisted of four main tasks: (1) a comprehensive review of current licensing guidelines, (2) a review of existing or near-term PWR extended-burnup RD and D programs, (3) an identification of the gaps or deficiencies (from a licensing standpoint) in the information being generated by the RD and D programs, and (4) recommendations/suggestions for additional development effort to improve the future licensing position of extended-burnup fuel. The assessment encompassed all phases of the nuclear fuel cycle including the fabrication, use, storage, handling, and transportation of extended-burnup fuel.

28679 (CONF-801038—(Vol.2), pp 1203-1204) **Nuclear standards and safety progress in nuclear standards development.** Fish, J.F. (American Air Filter Co., Inc., Louisville, KY). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Rev. 1 to N509 and Rev. 1 to N510, the equipment and test standards originally published in 1975 and 1976 have been approved, printed and are now available, 1980 edition. The need for certain changes became evident as a result of using the original documents. One thing of interest is that adsorbent qualification now follows ASTM Standards which became available during the revision period. Appendix B to N509 has been expanded to provide guidance in determining maximum test leakage for ducts and housings. Tables listing minimum instrumentation for both ESF and Non-ESF air cleaning units have been added. N510 has had both appendices expanded to provide more detail on the significance of in-place leak tests and leak test procedures. These editions will be the last for these two standards.

28680 **(NE-F—11-5T-Rev.) Determination of fuel pellet homogeneity by alpha-autoradiography.** (Oak Ridge National Lab., TN (USA); Hanford Engineering Development Lab., Richland, WA (USA)). Oct 1980. Contract W-7405-ENG-26. 21p. Nuclear Standards Management Center, Oak Ridge, TN. Order Number DE81027609.

This standard establishes the procedure for determining the homogeneity of plutonium oxide-uranium oxide (PuO_2-UO_2) fuel pellets by alpha-autoradiography.

2108 Economics

28681 **(LA—8899-MS) Analysis of nuclear power economics.** Hardie, R.W.; Thayer, G.R. (Los Alamos National Lab., NM (USA)). Jun 1981. Contract W-7405-ENG-36. 31p. NTIS, PC A03/MF A01. Order Number DE81028545.

This document is a briefing booklet that contains the results of an analysis of nuclear power economics. The format, consistent with a visual display, consists of charts, tables, and graphs interspersed with brief discussion sections.

2109 Process Heat Reactors

28682 **(GA-A—16074-Summ.) 1170-MW(t) HTGR-PS/C plant application study report: steel mill application.** Rao, R.; McMain, A.T. Jr.; Stanley, J.D. (General Atomic Co., San Diego, CA (USA)). May 1981. Contract AI03-76SF70046. 11p. NTIS, PC A02/MF A01. Order Number DE81027588.

This report summarizes a study to apply an 1170-MW(t) HTGR to a 6.5 x 10^6 tonne (7.2 x 10^6 ton) (liquid) per year steel plant. Such a reactor offers very low cost heat, because the fuel source is far cheaper than its leading competitors, including coal. Only its capital cost and difficulty of licensing are significant offsetting factors. The HTGR-PS/C can provide both electricity and high-temperature steam to flexibly meet steel mill needs and provide export electricity to the local utility grid. Such a reactor is too large for a single mill, and its economics become significantly poorer as the plant is scaled down from its reference 1170-MW(t) size. Nevertheless, if 30% of the energy demand is assumed to be supplied by 1170-MW(t) HTGR-PS/C units, then a potential market exists for 31 such units in the US steel industry. Steam from the HTGR would be utilized in other processes. The utility of the combined steam and electric supply greatly favors the HTGR over the light water reactor (LWR), because the LWR has lower maximum delivery temperature.

28683 **(GA-A—16083-Summ.) 1170-MW(t) HTGR-PS/C plant application study report: tar sands oil recovery application.** Rao, R.; McMain, A.T. Jr. (General Atomic Co., San Diego, CA (USA)). May 1981. Contract AT03-76SF70046. 10p. NTIS, PC A02/MF A01. Order Number DE81027905.

This report summarizes a study to apply an 1170-MW(t) high-temperature gas-cooled reactor - process steam/cogeneration (HTGR-PS/C) to tar sands oil recovery and upgrading. The raw product recovered from the sands is a heavy, sour bitumen; upgrading, which involves coking and hydrodesulfurization, produces a synthetic crude (refinable by current technology) and petroleum coke. Steam and electric power are required for the recovery and upgrading process. Proposed and commercial plants would purchase electric power from local utilities and obtain from boilers fired with coal and with by-product fuels produced by the upgrading. This study shows that an HTGR-PS/C represents a more economical source of steam and electric power.

28684 **(GA-A—16091-Summ.) 1170-MW(t) HTGR-PS/C plant application study report: H-coal coal liquefaction process application.** Rao, R.; McMain, A.T. Jr.; Neill, J.M. (General Atomic Co., San Diego, CA (USA)). May 1981. Contract AT03-76SF70046. 11p. NTIS, PC A02/MF A01. Order Number DE81027587.

Currently, a strong interest exists in developing and commercializing plants producing liquid and gaseous synthetic fuels derived from coal because of the national objective to reduce foreign oil imports. H-Coal liquefaction is one process under development, and this report summarizes a study to apply an 1170-MW(t) high-temperature gas-cooled reactor-process steam/cogeneration (HTGR-PS/C) to this process, based on a plant capacity of 27,200 tonnes (30,000 tons) per stream day.

28685 **(GA-A—16092-Summ.) 1170-MW(t) HTGR-PS/C plant application study report: shale oil recovery application.** Rao, R.; McMain, A.T. Jr. (General Atomic Co., San Diego, CA (USA)). May 1981. Contract AT03-76SF70046. 12p. NTIS, PC A02/MF A01. Order Number DE81027902.

The US has large shale oil energy resources, and many companies have undertaken considerable effort to develop economical means to extract this oil within environmental constraints. The recoverable shale oil reserves in the US amount to 160 x 10^9 m^3 (1000 x 10^9 bbl) and are second in quantity only to coal. This report summarizes a study to apply an 1170-MW(t) high-temperature gas-cooled reactor - process steam/cogeneration (HTGR-PS/C) to a shale oil recovery process. Since the highest potential shale oil reserves lie in th Piceance Basin of Western Colorado, the study centers on exploiting shale oil in this region.

28686 **(GA-A—16093-Summ.) 1170-MW(t) HTGR-PS/C plant application study report: heavy-oil-recovery application.** Rao, R.; McMain, A.T. Jr. (General Atomic Co., San Diego, CA (USA)). May 1981. Contract AT03-76SF70046. 13p. NTIS, PC A02/MF A01. Order Number DE81027594.

The US presently imports ~ 50% of the oil that it consumes, and a strong incentive exists to increase domestic oil production to reduce high uncontrolled payments for imported oil. About 15% of the domestic oil reserves are in the form of heavy crude oil (HCO), defined as having an American Petroleum Institute (API) gravity of <20°. The recovery of this heavy oil can be greatly improved by stimulation methods, such as steam injection. A study to apply an 1170-MW(t) high-temperature gas-cooled reactor - process steam/cogeneration (HTGR-PS/C) to recovering heavy oil is presented. The HTGR-PS/C was developed by General Atomic (GA) specifically for industries which require both steam and electric energy. The GA 1170-MW(t) HTGR-PS/C design is particularly well suited to industrial applications and is expected to have excellent cost benefits over other energy sources.

28687 **(GA-A—16094-Summ.) 1170-MW(t) HTGR-PS/C plant application study report: Geismar, Louisiana refinery/chemical complex application.** McMain, A.T. Jr.; Stanley, J.D. (General Atomic Co., San Diego, CA (USA)). May 1981. Contract AT03-76SF70046. 9p. NTIS, PC A02/MF A01. Order Number DE81027903.

This report summarizes a study to apply an 1170-MW(t) high-temperature gas-cooled reactor - process steam/cogeneration (HTGR-PS/C) to an industrial complex at Geismar, Louisiana. This study compares the HTGR with coal and oil as process plant fuels. This study uses a previous broad energy alternative study by the Stone and Webster Corporation on refinery and chemical plant needs in the Gulf States Utilities service area. The HTGR-PS/C was developed by General Atomic (GA) specifically for industries which require both steam and electric energy. The GA 1170-MW(t) HTGR-PC/C design is particularly well suited to industrial applications and is expected to have excellent cost benefits over other energy sources.

28688 **(GA-A—16100) 1170-MW(t) HTGR-PS/C plant application study report: alumina plant application.** Rao, R.; McMain, A.T. Jr.; Stanley, J.D. (General Atomic Co., San Diego, CA (USA)). May 1981. Contract AT03-76SF70046. 11p. NTIS, PC A02/MF A01. Order Number DE81027586.

This report considers the HTGR-PS/C application to producing alumina from bauxite. For the size alumina plant considered, the 1170-MW(t) HTGR-PS/C supplies 100% of the process steam and electrical power requirements and produced surplus electrical power and/or process steam, which can be used for other process users or electrical power production. Presently, the bauxite ore is reduced to alumina in plants geographically separated from the electrolysis plant. The electrolysis plants are located near economical electric power sources. However, with the integration of an 1170-MW(t) HTGR-PS/C unit in a commercial alumina plant, the excess electric power available [~ 233 MW(e)] could be used for alumina electrolysis.

28689 **(GA-A—16108-Summ.) 1170-MW(t) HTGR-PS/C plant application study report: SRC-II process application.** Rao, R.; McMain, A.T. Jr. (General Atomic Co., San Diego, CA (USA)). May 1981. Contract AT03-76SF10046. 11p. NTIS, PC A02/MF A01. Order Number DE81027904.

The solvent refined coal (SRC-II) process is an advanced process being developed by Gulf Mineral Resources Ltd. (a Gulf Oil Corporation subsidiary) to produce a clean, non-polluting liquid fuel from high-sulfur bituminous coals. The SRC-II commercial plant will process about 24,300 tonnes (26,800 tons) of feed coal per stream day, producing primarily fuel oil plus secondary fuel gases. This summary report describes the integration of a high-temperature gas-cooled reactor operating in a process steam/cogeneration mode (HTGR-PS/C) to provide the energy requirements for the SRC-II process. The HTGR-PS/C plant was developed by General Atomic Company (GA) specifically for industries which require energy in the form of both steam and electricity. General Atomic has developed an 1170-MW(t) HTGR-PS/C design which is particularly well suited to industrial applications and is expected to have excellent cost benefits over other sources of energy.

28690 **(GA-A—16113-Summ.) 1170-MW(t) HTGR-PS/C plant application study report: Exxon catalytic coal gasification process application.** Rao, R.; McMain, A.T. Jr.; Peterman, D.D. (General Atomic Co., San Diego, CA (USA)). May 1981. Contract AT03-76SF70046. 12p. NTIS, PC A02/MF A01. Order Number DE81027589.

This report summarizes a study to apply the high-temperature gas-cooled reactor - process steam/cogeneration (HTGR-PS/C) to Exxon catalytic coal gasification. The industry is currently strongly interested in developing and commercializing plants producing liquid and gaseous synthetic fuels derived from coal, based on the national objective to reduce foreign oil imports and to use the abundant US coal. Exxon catalytic coal gasification (ECCG) is one gasification process under development.

28691 **(GA-A—16212) Computer codes for design and optimization of large complex plants.** Plesic, F.A.; Covert, R.E.; Malek, G.J. (General Atomic Co., San Diego, CA (USA)). Jun 1981. Contract AT03-76ET35301. 27p. (CONF-810417—8). NTIS, PC A03/MF A01. Order Number DE81027514.

From 90. AICHE national meeting; Houston, TX, USA (5 Apr 1981).

This paper describes the development and application of computer codes which model an entire nuclear plant design and estimate relative capital and operating costs. These codes are characterized by large size and complex interactions between components, systems, performance, and cost. These codes evolve with the project and are used to evaluate alternate configurations and define major design parameters, in preliminary design to optimize cost and guide decisions on integrating requirements into the design - like space for accessibility or reduction in stress of a critical component, and in final design to efficiently utilize final design data and test results. This paper details the application of this approach to a steam-hydrocabon reforming plant using a nuclear heat source and gives typical results from this and other applications.

28692 **(GA-A—16364) Application of the HTGR in tar sands oil recovery.** Rao, R.; McMain, A.; Quade, R. (General Atomic Co., San Diego, CA (USA)). May 1981. Contract AT03-76SF70046. 8p. (CONF-8006182—1). NTIS, PC A02/MF A01. Order Number DE81024386.

From 2. Canadian Nuclear Society annual meeting; Ottawa, Canada (8 Jun 1980).

The study presented in this paper explored the potential application of a high-temperature gas-cooled reactor (HTGR) to supply both process steam and cogenerated electric power for tar sands oil recovery and upgrading. The raw product recovered from the tar sands is a heavy bitumen. No attempt has been made to describe the details of the bitumen recovery technology or the upgrading process in this paper. Only their energy requirements by form are considered. The results of this study indicate that an HTGR plant could be the most economical source of steam and electric power. This paper includes a description of the HTGR plant, a heat cycle and energy balance developed for a typical commercial tar sands oil recovery operation, and a schematic field arrangement showing the coupling of the HTGR to the process. Data developed during this study include expected bitumen recovery, economic data, and a comparative assessment of the HTGR application for tar sands recovery.

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory And Calculation

REFER ALSO TO CITATION(S) 29497

28693 **(ORNL-tr—4764) Decay heat curve evaluation test (V).** Akiyama, M.; Doda, K.; Ida, T.; Hashidura, H.; Oka, M.; Yasu, N. (Oak Ridge National Lab., TN (USA)). Mar 1981. Translation of UTNL-R 0103. 62p. NTIS, PC A04/MF A01. Order Number DE81027181.

Fission-product decay energy release rates have been measured for fast neutron fissions of ^{235}U, ^{239}Pu, ^{238}U, ^{232}Th and natural uranium for gamma-ray, and ^{235}U and ^{239}Pu for beta-ray. The samples were irradiated at Fast Neutron Source Reactor YAYOI, and returned pneumatically to a counting area. Gamma-ray energy spectra were measured using a NaI scintillation detector and beta-ray energy spectra were obtained using a plastic scintillation detector combined with a transmission type proportional counter to eliminate gamma-ray effects. The measurements were made covering times following irradiations from 19 to 24,000 seconds. The spectra data were integrated to provide total energy release rates as a function of time after fission. The present data of beta-ray energy release rates are preliminary due to current carrying out of the data analyses. Typical uncertainties in the present data are $\sim$ 5% (1σ) except for ^{233}Th, and $\sim$ 8% for ^{232}Th. The present results were compared with the results of summation calculations using the TASAKA, ENDF/B-IV and JNDC decay data files.

28694 **(ORNL-tr—4763) Decay-heat-curve evaluation test (IV).** Akiyama, K.; Sakata, K.; Oka, K.; Yasu, N. (Oak Ridge National Lab., TN (USA)). Jan 1980. Translation of UTNL-R R-0083, 1978. 31p. NTIS, PC A03/MF A01. Order Number DE81027182.

The irradiation facility and measuring system for measuring the gamma and beta-energy release rates from the fission products at the short cooling time were prepared, and these properties were confirmed by the experiments.

2202 Components And Accessories

28695 (CONF-801038—(Vol.2), pp 1414-1419) **Nuclear power plant air filter maintenance program and records.** Fish, J.F. (American Air Filter Co., Inc., Louisville, KY). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Air filter maintenance can be and often is a casual requirement for commercial and industrial buildings, fossil power plants and similar installations. This, often off-hand approach is not good enough for Nuclear Power Plants where air filtration systems must be in good operating condition at all times to protect plant workers and the general public from emissions in case of accident. This process is not complicated but to be effective, it must be introduced and followed up as a standard procedure. Simple records will suffice to indicate condition of all filtration systems to (1) company supervisory personnel, or (2) government inspectors at any time. Responsibility for periodic checks must be assigned to specific personnel to make the system work. Procedures must be specifically drawn up and responsibility specifically assigned.

28696 **Resistance temperature detector time response testing by the self-heating method.** Burton, D.A. (Duke Power Co., Charlotte, NC). pp 155-159 of Instrumentation in the power industry, Volume 23. Good, E.M. (ed.). Research Triangle Park, NC; Instrument Society of America (1980).

From 23. ISA power instrumentation symposium; Chicago, IL, USA (14 May 1980).

When the Nuclear Regulatory Commission requirements on Response Time Testing expanded to include sensors, a search for an adequate, reliable and inexpensive in-situ test method for Platinum Resistance Temperature Detectors was initiated. The correlation of Self-Heating Index to response time was researched under an EPRI contract, and the program, presented here, to accomplish in-situ RTD Response Time Testing by the Self-Heating method was developed by Duke Power Company. This presentation includes: Theory of Self-Heating and characterization, program description and documentation, Assumption Verification Plan, Ultimate Goals of the Program, and experience to date (Testing of Twenty-Two RTD's for McGuire Nuclear Station, Unit 1).

2203 Fuel Elements

REFER ALSO TO CITATION(S) 28680

28697 **(HEDL—7004) New instrumental method for determining noble fission gas retained in irradiated nuclear fuels.** Baldwin, D.L. (Washington State Univ., Pullman (USA). Dept. of Chemistry). 1981. Contract AC14-76FF02170. 37p. NTIS, PC A03/MF A01. Order Number DE81024392.

The measurement of fission products generated in nuclear fuel is necessary for the complete characterization of the irradiated fuel. The gaseous fission products, xenon and krypton, are of particular importance. A new method has been developed for the measurement of the fission gas retained in nuclear fuel. The method involves extraction of xenon and krypton by melting the fuel in a commercially available furnace. Several factors influence the complete fusion of the fuel and release of the noble gases. Development work aimed at identifying and understanding these factors is discussed. The gases are purified after release from the fuel and collected on cryogenically-cooled activated charcoal. The gases are subsequently released from the charcoal trap and measured by gas chromatography. Column requirements and optimum operating conditions are discussed. Various modifications to the furnace are necessary for reliable performance within the high radiation environment. Other radiological problems are identified and their solutions discussed.

28698 **(LA-UR—81-1662) Reconstruction of radial fission-product distributions in reactor fuels from a small number of projections.** Barnes, B.K.; Phillips, J.R.; Barnes, M.L. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 10p. (CONF-8106102—1). NTIS, PC A02/MF A01. Order Number DE81025291.

From Conference on characterization and quality control of nuclear fuels; Karlsruhe, F.R. Germany (2 Jun 1981).

Four mathematical techniques for reconstruction of the radial two-dimensional distribution of fission products using projections obtained by nondestructive gamma scanning were evaluated. Reconstruction of a picture from a finite set of projections is mathematically indeterminate; therefore, reconstruction techniques are heuristic, particularly when only a small number of projections are available. Of the techniques evaluated, the filtered backprojection algorithm provided the best reconstruction for simulated gamma-ray sources, as well as for actual irradiated fuel material.

2204 Control Systems

28699 **Humanizing the power plant control room.** Fredricks, P. (Ebasco Services Inc., New York, NY). pp 149-153 of Instrumentation in the power industry, Volume 23. Good, E.M. (ed.). Research Triangle Park, NC; Instrument Society of America (1980).

From 23. ISA power instrumentation symposium; Chicago, IL, USA (14 May 1980).

The paper discusses control room and control board factors which can help plant operators do a better job. It focuses on seven areas of control room environment, control board design and operator information systems. Valuable ideas from present designs are reinforced and other ideas are advanced. Each idea is based on the view of the operator as a normal human being with normal responses.

28700 **Environmental qualification of nuclear power plant control equipment.** Hall, R.A.; Gleason, J.F. (Wyle Labs., Huntsville, AL). pp 161-169 of Instrumentation in the power industry, Volume 23. Good, E.M. (ed.). Research Triangle Park, NC; Instrument Society of America (1980).

From 23. ISA power instrumentation symposium; Chicago, IL, USA (14 May 1980).

The nuclear power industry is required to qualify safety-related equipment and systems to provide assurances that they will perform properly when required throughout the life of the Nuclear Power Generating Station. Implementation of equipment qualification requirements as defined in IEEE 323-1974, IEEE Standard for Qualifying Class IE Equipment for Nuclear Power Generating Stations, and US Nuclear Regulatory Commission Regulatory Guide 1.89, Qualification of Class IE Equipment for Nuclear Power Plants, requires the development of a practical methodology in order to meet the goals in a practical and efficient manner. The methodology developed by Wyle Laboratories is presented in this paper.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 28201, 28217, 28223, 28224, 28229, 28238, 28246, 28247, 28257, 28259

28701 (CONF-801038—(Vol.1), pp 233-251) **Dynamic analysis of the CRBRP clean-up system (three stage aqueous scrubber).** Kyi, R.; Bijlani, C.; Fazekas, P.; Dajani, A. (Burns and Roe, Inc., Oradell, NJ). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

The CRBRP containment clean-up system design required the determination of the thermal-hydraulic performance of the system during its projected operating cycle. The reduced scale component tests at HEDL provided valuable information about the generic performance of the components; however, due to the limitations of the test facility the exact simulation of the actual CRBRP conditions was not feasible. A computer program was developed to permit dynamic system analysis of the full size air cleaning system. The dynamic system analysis considered the mass and energy balances across each component. In addition to the major filtration system components, the system modeling included the supporting fluid system components such as pumps, tanks and heat exchangers. Variable gas flow, temperature, chemical concentrations, and other system parameters were also modeled. Fission product heat, chemical reaction heat and heat of solution were considered. The analysis results provided sodium hydroxide solution concentrations and temperatures, gas temperatures and other variables at the various components within the air cleaning system for each calculated time interval. The accuracy of the computer modeling was verified by comparing the calculated results with HEDL test data. The comparison indicated a better than +-10% agreement with the test data. The analysis results provided the basis for the selection of the system components.

28702 (CONF-801038—(Vol.1), pp 252-290) **Consistent approach to air-cleaning system duct design.** Miller, W.H.; Ornberg, S.C.; Rooney, K.L. (Sargent and Lundy Engineers, Chicago, IL). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Nuclear power plant air-cleaning system effectiveness is dependent on the capability of a duct system to safely convey contaminated gas to a filtration unit and subsequently to a point of discharge. This paper presents a logical and consistent design approach for selecting sheet metal ductwork construction to meet applicable criteria. The differences in design engineers' duct construction specifications are acknowledged. Typical duct construction details and suggestions for their effective use are presented. Improvements in duct design sections of ANSI/ASME N509-80 are highlighted. A detailed leakage analysis of a control room HVAC system is undertaken to illustrate the effects of conceptual design variations on duct construction requirements. Shortcomings of previously published analyses and interpretations of a current standard are included.

28703 (CONF-801038—(Vol.1), pp 291-316) **Effects of secondary containment air cleanup system leakage on the accident offsite dose as determined during preop tests of the Sequoyah Nuclear Plant.** Klaes, L.J.; Nass, S.A.; Proctor, L.D. (Tennessee Valley Authority, Knoxville). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

The Sequoyah Nuclear Plant has two secondary containments. One is the annular region between the primary containment and the shield building surrounding the primary containment. The second is the auxiliary building secondary containment enclosure which is potentially subject to direct airborne radioactivity. Two air cleanup systems are provided to serve these areas. The emergency gas treatment system (EGTS) serves the annulus between the primary containment and the shield building, and the auxiliary building gas treatment system (ABGTS) serves the area inside of the auxiliary building secondary containment enclosure. The major function served by these air cleanup systems is that of controlling and processing airborne contamination released in these areas during any accident up to a design basis accident. This is accomplished by (1) creating a negative pressure in the areas served to ensure that no unprocessed air is released to the atmosphere, (2) providing filtration units to process all air exhausted from the secondary containment spaces, and (3) providing a low-leakage enclosure to limit exhaust flows. Offsite dose effects due to secondary containment release rates, bypass leakage, and duct and damper leakages are presented and parameter variations are considered. For the EGTS, a recirculation system, the most important parameter is the total inleakage of the system which causes an increase in both whole body (gamma) and thyroid (iodine) doses. For the ABGTS, a once-through system, the most important paramter is the inleakage which bypasses the filters resulting in an increase in the thyroid dose only. Actual preoperational test data are utilized. Problems encountered during the preop test are summarized. Solutions incorporated to bring the EGTS and ABGTS air cleanup systems within the test acceptance criteria required to meet offsite dose limitations are discussed and the resultant calculated offsite dose is presented.

28704 (CONF-801038—(Vol.1), pp 373-394) **Theoretical and experimental investigations into the filtration of the atmosphere within the containments of pressurized water reactors after serious reactor accidents.** Dillmann, H.G.; Pasler, H. (Kernforschungszentrum Karlsruhe, Germany). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

For serious accidents in nuclear power stations equipped with pressurized water reactors and with boundary conditions assumed, a conservative evaluation was made of the condition of the atmosphere within the reactor containment, particularly referring to pressure, temperature, air humidity and activity release. Based on these data the loads were calculated of accident filter systems of different designs as a function of parameters such as the course of releases and the volume flow through the filter systems. A number of experimental results are indicated on the behaviour of iodine sorption materials under extreme conditions including the least favorable temperature, humidity and pressure derived from the calculations above. Reference is made to the targets of future R and D work on aerosol removal.

28705 (CONF-801038—(Vol.1), pp 417-436) **Evolution and current state of radio-iodine control.** Kovach, J.L. (Nuclear Consulting Services, Inc., Columbus, OH). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

The history, development, and problems existing in the US nuclear power reactor iodine clean-up technology are discussed. The areas of iodine transport in containment, adsorbent types, impregnation effects, mechanical and testing problems are reviewed, particularly in view of the TMI-II accident. The problems resulting from the fragmentation of responsibility and the very slow transfer of technology from research to application are pointed out.

28706 (CONF-801038—(Vol.1), pp 465-486) **Behavior of gasketless deep bed charcoal filters for radioiodine removal in LWR power plants.** Wilhelm, J.G.; Deuber, H.; Furrer, J.; Gerlach, K. (Kernforschungszentrum Karlsruhe, Germany). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

The removal efficiency of radioiodine filters can be affected by mechanical leakage, aging and poisoning, desorption of radioiodine originally removed by the activated carbon and also by the occurrence of penetrating iodine compounds. To provide high decontamination factors only the gasketless deep bed filter type seems to be appropriate. The experience gathered and the data given in this paper are based on the surveillance testing of radioiodine filters in all German nuclear power plants and on laboratory research work which has been done over years to evaluate the operating behavior of deep bed radioiodine filters and to prove their reliability.

28707 (CONF-801038—(Vol.1), pp 504-518) **Operational silver zeolite iodine adsorption system.** McDaniel, J.H.; White, E.R. (EG and G Idaho, Inc., Idaho Falls). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

This paper describes the rationale used to justify silver zeolite as the iodine adsorption medium in a single-housed multi-stage filtration unit to be used as the Loss-of-Fluid-Test (LOFT) containment vessel atmosphere cleanup system and reports the status of the system after two years of operation. The system is required to (1) remove entrained moisture, (2) reduce relative humidity, if necessary, (3) remove particulates both upstream and downstream of the adsorption medium, and (4) remove iodine by adsorption in an 8000-cfm system. Cost analysis and feasibility studies were conducted and showed that a single-housed multi-stage filter train with a Type-13X silver zeolite gasketless adsorber was the most cost effective and practical concept. Design, installation, and operational problems are discussed. The system efficiency test results are noted showing no degradation from the two years of operation. The operational problems have been minor and can easily be corrected in future units by making small modifications in the system design.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 28672, 28694, 28728, 28730, 28731, 29127

28708 **(CONF-810606—83) Examination of the first irradiated LOFT fuel module.** Cook, J.A.; Olsen, C.S. (EG and G Idaho, Inc., Idaho Falls (USA)). 1981. Contract AC07-76ID01570. 10p. NTIS, PC A02/MF A01. Order Number DE81027113.

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

The first Loss-of-Fluid Test (LOFT) center fuel module was nondestructively examined in order to assess any changes after power range testing and three large-break loss-of-coolant experiments (LOCEs). The examination consisted of evaluation of LOCE measurement data; measurement of withdrawal forces during removal of the module from the reactor; poolside examination of the exposed fuel module surfaces, using an underwater periscope, 35-mm camera, and closed circuit television; and poolside measurements of the rod-to-rod spacing, using a Sulo probe. The performance of the equipment is assessed from the results of the examination. Color standards are required for underwater color photography, and fuel rod deflection must be considered in evaluting rod-to-rod spaces.

28709 **(DOE/ER/03355—4) Utilization of MIT research reactor by Boston-area universities. Final report, July 1, 1978-June 30, 1980.** Clark, L. Jr.; Janghorbani, M. (Massachusetts Inst. of Tech., Cambridge (USA). Nuclear Reactor Lab.). Jul 1981. Contract AC02-76ER03355. 6p. NTIS, PC A02/MF A01. Order Number DE81027120.

The guest institutions which used the MITR reactor during 1978-1979 are listed. The participation during previous years since the program began at MIT is also indicated. A summary of the type and amount of participation by local institutions is given.

28710 **(HEDL-UOR—78-012) Failure of the CAPS compressor(s). Final unusual occurrence report.** Kuechle, J.D. (Hanford Engineering Development Lab., Richland, WA (USA)). 29 Apr 1981. Contract AC14-76FF02170. 4p. NTIS, PC A02/MF A01. Order Number DE81027539.

Acceptance testing of the CAPS compressors (4) was in progress which required periodic running of these units. Some vibration problems had occurred which required compressor shutdown for visual inspection and repair. During the performance of this visual inspection, it was decided to remove the crank case covers and to inspect the lower section of the cylinder liners for wear. The inspection revealed excessive scoring of the vertical cylinder liners on two of the four compressors that were opened. Acceptance testing of the CAPS compressors was suspended, pending further evaluation and repair.

28711 **(HEDL-UOR—79-051) Oil in the FFTF secondary loop cover gas piping. Final unusual occurrence report.** Kuechle, J.D. (Hanford Engineering Development Lab., Richland, WA (USA)). 27 Apr 1981. Contract AC14-76FF02170. 6p. NTIS, PC A02/MF A01. Order Number DE81027540.

The final unusual occurrence report describes the discovery of oil in the FFTF secondary sodium system cover gas piping. A thorough evaluation has been performed and corrective actions have been implemented to prevent a recurrence of this event.

28712 **(HEDL-UOR—80-011) Malfunction of an FFTF diesel generator. Final unusual occurrence report.** Smith, R.R. (Hanford Engineering Development Lab., Richland, WA (USA)). 30 Apr 1981. Contract AC14-76FF02170. 5p. NTIS, PC A02/MF A01. Order Number DE81027544.

The diesel generator output breaker (B4A-02) closed on an energized bus after malfunction of diesel generator No. 1 switchgear circuits. An Operations Test Procedure was in progress to measure the diesel engine oil pressure. The engine was manually started per the operating procedure. The engine came up to a speed normally and then started to coast down in speed until it stopped. During this time an operator attempted to restart the engine, but it would not restart due to an expected low lube oil alarm. Several minutes after the startup was attempted, the operator noted that both the open and closed indicating lights for the diesel generator output breaker were lit. The operator moved the breaker remote control switch from the after-trip to the trip position and nearly simultaneously noted the bus voltage increase from approximately 300 volts to 480 volts and the closed light go out. The normal bus voltage is 480 volts.

28713 **(HEDL-UOR—80-012) Electrical shock to an FFTF electrician. Final unusual occurrence report.** Smith, R.R. (Hanford Engineering Development Lab., Richland, WA (USA)). 2 Apr 1981. Contract AC14-76FF02170. 5p. NTIS, PC A02/MF A01. Order Number DE81027571.

The final Unusual Occurrence Report describes an electrical shock which was experienced by an FFTF electrician during the replacement of a primary sodium pump motor. The electrician experienced no permanent physical injury and the occurrence had no effect on the FFTF Project Schedule.

28714 **(HEDL-UOR—80-043) Unusual occurrence report.** (Hanford Engineering Development Lab., Richland, WA (USA)). 29 May 1981. Contract AC14-76FF02170. 5p. NTIS, PC A02/MF A01. Order Number DE81027570.

The final report provides information on an occurrence which took place in the HEDL Radioactive Liquid Waste System (RLWS), during which radioactive waste water entered the Retention Process Waste System. The RLWS has been cleared of the obstruction and is in full operation. Investigation of the occurrence and testing of the equipment involved is completed.

28715 **(DOE/SF/72024—T7) Buildings and facilities presentation.** Cerutti, B.C. (General Electric Co., Sunnyvale, CA (USA)). [nd]. Contract AT03-76SF72024. 83p. NTIS, PC A05/MF A01. Order Number DE81026838.

A description is presented of the reactor site, building arrangements, and reactor systems.

2207 Plutonium And Isotope Production Reactors

REFER ALSO TO CITATION(S) 28731

28716 (LA—8867) Alternatives to proposed replacement production reactors. Cullingford, H.S. (Los Alamos National Lab., NM (USA)). Jun 1981. Contract W-7405-ENG-36. 28p. NTIS, PC A03/MF A01. Order Number DE81026803.

To insure adequate supplies of plutonium and tritium for defense purposes, an independent evaluation was made by Los Alamos National Laboratory of the numerous alternatives to the proposed replacement production reactors (RPR). This effort concentrated on the defense fuel cycle operation and its technical implications in identifying the principal alternatives for the 1990s. The primary options were identified as (1) existing commercial reactors, (2) existing and planned government-owned facilities (not now used for defense materials production), and (3) other RPRs (not yet proposed) such as CANDU or CANDU-type heavy-water reactors (HWR) for both plutonium and tritium production. The evaluation considered features and differences of various options that could influence choice of RPR alternatives. Barring a change in the US approach to civilian and defense fuel cycles and precluding existing commercial reactors at government-owned sites, the most significant alternatives were identified as a CANDU-type HWR at Savannah River Plant (SRP) site or the Three Mile Island commercial reactor with reprocessing capability at Barnwell Nuclear Fuel Plant and at SRP.

28717 (LA—8898-MS) Some issues related to possible power generation as a by-product of special nuclear materials production. Jackson, S.V. (Los Alamos National Lab., NM (USA)). Jun 1981. Contract W-7405-ENG-36. 37p. NTIS, PC A03/MF A01. Order Number DE81026672.

Various nontechnical issues that may arise for electric power generation by a Replacement Production Reactor project are explored and evaluated based on the possible introduction of impediments to the reactor construction and operation. The problems of a new production facility as a major power consumer are also evaluated. There are definite advantages for the power-generation case whereas the power-consumption case introduces significant barriers to the project. For the power-generation case, a system in which the reactor and generator are separate facilities minimizes the barriers to the construction of the total production facility.

28718 (ORNL/TM—7749) Eddy-current inspection of high flux isotope reactor nuclear control rods. Smith, J.H.; Chitwood, L.D. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 80p. NTIS, PC A05/MF A01. Order Number DE81027066.

Inner control rods for the High Flux Isotope Reactor were nondestructively inspected for defects by eddy-current techniques. During these examinations aluminum cladding thickness and oxide thickness on the cladding were also measured. Special application techniques were required because of the high-radiation levels (~ 10^5 R/h at 30 cm) present and the relatively large temperature gradients that occurred on the surface of the control rods. The techniques used to perform the eddy-current inspections and the methods used to reduce the associated data are described.

28719 (ORNL/TM—7890) High Flux Isotope Reactor. Quarterly report, October, November, and December of 1980. Corbett, B.L.; Poteet, K.H. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 20p. NTIS, PC A02/MF A01. Order Number DE81027064.

Routine reactor operation with four end-of-cycle shutdowns and one scheduled midcycle shutdown resulted in an on-stream time of 89.1% for the quarter. The outer control plates were replaced, and a semiannual core component inspection was made.

28720 (UNI-SA—79) QA's role in the independent verification of plant readiness for startup from planned outages. McGuire, J.J.; Snyder, D.A. (UNC Nuclear Industries, Inc., Richland, WA (USA)). 18 Feb 1981. Contract AC06-76RL01857. 18p. (CONF-810921—1). NTIS, PC A02/MF A01. Order Number DE81024334.

From 8. annual ASQC national energy division conference; Pheonix, AZ, USA (21 Sep 1981).

Quality Assurance (QA) personnel at the N Reactor, located near Richland, Washington, USA, perform many activities to independently verify the readiness for startup of the reactor from planned outages. The verifications are performed as inspections, test witnessing, audits, surveillance, and followup on identified corrective action needs. The results of these verifications are used in a formal readiness review process. The formal reviews are administered by a Review Board of representatives from several major components of the Company and are conducted using systematically structured analytical techniques. The N Reactor QA staff includes 26 persons (excluding managers) who are involved in independent verifications of reactor-related work as part or all of their assigned functions.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 29366, 29561

28721 (BNL—29632) Planning on a regional basis for a major radiation accident. Casey, W.R. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 17p. (CONF-810483—2). NTIS, PC A02/MF A01. Order Number DE81025079.

From NCRP symposium; Reston, VA, USA (27 Apr 1981).

As a part of the Radiological Assistance Program, members of the Safety and Environmental Protection Division of Brookhaven National Laboratory have served as a response team for many years to the northeastern section of the United States. During this time, responses have been made to several significant incidents, including the accident at Three Mile Island. The planning and preparation for emergency response activities will be discussed. Included will be a review of instrument requirements, analytical and support equipment, modes of response, and communication needs. Interaction with and support from other response teams will be discussed. In particular, the lessons from the respone to Three Mile Island will be reviewed.

28722 (CONF-801038—(Vol.1), pp 7-15) **Impact of the accident at TMI-2 on new safety regulations.** Collins, J.T. (Nuclear Reactor Regulation, Washington, DC). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

The Nuclear Regulatory Commission (NRC) has been very busy, since the accident, looking into the causes surrounding the events that occurred on the morning of March 28, 1979. To date, the Commission has implemented the Short-Term Lessons Learned and has provided a schedule for implementing the Long-Term Lessons Learned. Some of these requirements have resulted in delays in licensing of new plants and the temporary shutdown of some operating plants. However, the NRC believes these new requirements are essential to increase the safety of nuclear power plants and to protect the health and safety of the public. Although the accident occurred almost 19 months ago, the cleanup of TMI-2 continues and will continue for the next 5 to 7 years. As the cleanup progresses and ultimately the fuel removed, the Commission will continue to learn from the information generated by this program. This information will be factored into the licensing process. If nuclear power is to remain a viable option as a source of electrical power in the United States, then NRC must continue to assure the general public that these plants can be operated safely from the lessons learned at TMI and that systems required to mitigate the consequences of accidents will indeed perform their intended functions.

28723 (CONF-801038—(Vol.1), pp 225-232) **Experimental data required for the design and analysis of emergency filtered air discharge sytems.** Jefford, J.D.; Fluke, R.J. Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

The radiological consequences of an accident in a CANDU nuclear generating station are mitigated by special safety systems which include an Emergency Filtered Air Discharge (EFAD) system. EFAD systems are designed to provide a controlled leak-

age path following an accident. They remove radioiodine and particulates from the air discharge required, to inhibit uncontrolled emissions by maintaining containment sub-atmospheric in the long term. The design and analysis of an EFAD system requires an accurate data base comprised of the numerous parameters involved in the simulation of fission product behaviour within containment. This paper emphasizes the data requirements of EFAD system design with regard to those parameters which preliminary sensitivity analyses have shown to most effect environmental releases. These include the source term radioisotopes; their chemical behaviour and distribution within containment; the repressurization time during the vacuum hold-up period; and parameters effecting the long term releases through the EFAD system. The net radioiodine trapping efficiency of charcoal filters in the long term is dependent on the adsorption efficiency and desorption of the deep charcoal bed. These are a function of many parameters such as impregnate, aging, humidity, temperature, radiation, recirculation, etc. Although the effect of these parameters on charcoal filters has been individually investigated, generally at ideal or extreme values, there is little applicable data to determine their combined effect under expected post accident operating conditions. As a consequence, designers tend to overdesign by using unduly conservative parameters. A summary comparison is presented to illustrate the information gap between the experimental data from the literature and the data required for optimal design and analysis of the EFAD systems.

28724 (CONF-801038—(Vol.2), pp 1195-1201) **Three Mile Island recovery program.** Collins, J.T. Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

The status of the cleanup program at Three Mile Island Unit 2 as a result of the accident that occurred on March 28, 1979 is discussed. The current status of the plant and the reactor, the financial problems that have plagued Metropolitan-Edison Co., the licensee and owner of TMI, since the accident, and the impact this is having on the cleanup operations are analyzed. The first and second entries into the containment building of TMI-2 are reviewed.

28725 (CONF-801038—(Vol.2), pp 1427-1441) **Investigations into the air cleaning aspects of the Three Mile Island accident.** Bellamy, R.R. (Nuclear Regulatory Commission, Middletown, PA). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Investigative groups that have placed heavy emphasis on analysis of the air cleaning systems have included the President's Commission on the Accident at Three Mile Island (chaired by J. Kemeny), the Office of Inspection and Enforcement of the US Nuclear Regulatory Commission (two studies done independently, one by an Investigative Team, the other by a Special Review Group), internal USNRC Task Forces formed specifically for this purpose (termed Lessons Learned), and an independent USNRC Special Inquiry Group staffed primarily by USNRC but under the outside supervision of attorney M. Rogovin (the Rogovin Report). The efforts of these groups in the air cleaning area are described. The mechanisms whereby gaseous radioactive materials were released are discussed. The efforts of the various investigative groups for the Three Mile Island accident pertaining to air cleaning technology, the recommendations these groups have made, and the potential impact on the nuclear industry of the implementation of these recommendations are reviewed.

28726 (CONF-801038—(Vol.2), pp 1442-1480) **Studies of airborne iodine at TMI-2, sources and filtration.** Cline, J.E.; Voilleque, P.G.; Pelletier, C.A.; Thomas, C.D. Jr. (Science Applications, Inc., Rockville, MD). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

In April 1979, SAI began an evaluation of the behavior of airborne radioiodine at Unit 2 of the Three-Mile-Island nuclear plant. The experimental portion of the radioiodine sampling program continued from May until September 1979. Two specific tasks were addressed in the study. These were: identify specific sources of radioiodine within the auxiliary and fuel-handling buildings; and measure the retention efficiencies of the auxiliary and fuel-handling building charcoal filters and the supplementary filter banks on the auxiliary building roof for ^{131}I.

28727 (CONF-801038—(Vol.2), pp 1500-1518) **Evaluation of carbons exposed to the Three Mile Island accident.** Deitz, V.R. (Naval Research Lab., Washington, DC); Romans, J.B.; Bellamy, R.R. Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

One of the lines of defense that served to mitigate the radiological effects of the accident at Three Mile Island was the activated carbon installed in ventilation air flows. Filters in the Auxiliary and Fuel Handling Buildings of Unit 2 adsorbed tens to hundreds of curies of iodine-131, preventing the release to the environment. The carbon exposed to the accident has been replaced and the spent carbon has been analyzed in the laboratory. Independent analyses were performed for the two filter trains in both the Auxiliary and Fuel Handling Buildings, replaced at various times after the accident. The results of these analyses are compared to new (unexposed) carbons.

28728 **(CONF-810606—84) Mechanistic analysis of loft pulsed neutron activation data.** Perez-Griffo, M.L.; Block, R.C.; Lahey, R.T. Jr. (Rensselaer Polytechnic Inst., Troy, NY (USA)). 1981. Contract AC07-76ID01570. 7p. NTIS, PC A02/MF A01. Order Number DE81027124.

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

Pulsed Neutron Activation (PNA) is a technique for measuring mass-weighted flow velocities without perturbing the flow. Monte Carlo PNA tagging and Monte Carlo detection calculations of the irradiated fluid with the transport of the irradiated fluid are used to predict the time spectrum in a PNA measurement. This mechanistic method has been used to analyze recent LOFT PNA measurements of single-phase water flowing in a 14-in. (0.35 m) schedule 160 steel pipe.

28729 **(DOE/SF/73002—T4) Testing recommendations and data requirements related to transient overpower LMFBR fuel-rod-performance modeling.** Sherry, R.R.; Atcheson, D.B. (General Electric Co., Sunnyvale, CA (USA). Energy Systems and Technology Div.). Jan 1976. Contract AT03-76SF73002. 100p. NTIS, PC A05/MF A01. Order Number DE81026974.

This memo contains test recommendations designed to provide the data requied for developing transient overpower (TOP) fuel rod performance models. Through experience gained from fuel rod performance model development and TOP experiment analysis, areas have been identified where data is required to characterize both the pre-failure and post-failure phases of a TOP event. The recommended tests are designed to identify and quantify the important pre-failure cladding loading mechanisms (fission gas effects, thermal expansion and cladding melt-through). The recommended tests include both in-pile and out-of-pile experiments and both complex (integral) tests and simpler model development (differential) tests.

28730 **(DOE/SF/73002—T5) Overview and evaluation of transient test data from TREAT overpower experiments.** Atcheson, D.B. (General Electric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.). 6 Jan 1976. Contract AT03-76SF73002. 128 p. NTIS, PC A07/MF A01.

Portions of document are illegible.

One of the tasks assigned to the Safety Engineering program (189 No. SG002) by ERDA is to identify TREAT overpower experiments needed to support mechanistic cladding failure modeling. One of the steps taken to satisfy this request was to characterize the TREAT data currently available and to identify parameter ranges where no data exist. This memo reports the results of that investigation. Sixty-six TREAT overpower experiments are described by a compilation of 22 experiment parameters. Graphical analysis is applied to determine the combinations of parameters not represented in the current data set. Graphical analysis is also used to identify possible trends in the data. Experiment series are identified which

can fill existing gaps and/or confirm possible trends in the current data base. These series are identified in terms of parameter ranges to be covered. The number of experiments, and the test parameters for each, are not specified. Instead, an illustrative calculation is performed using statistical experiment design techniques.

28731 **(DOE/US—0005) Safety assessment of Department of Energy nuclear reactors.** (Department of Energy, Washington, DC (USA)). Mar 1981. 129p. NTIS, PC A07/MF A01. Order Number DE81027530.

One of the first tasks of the NFPQT Committee was to determine which DOE reactors would be assessed. The Committee determined that in view of the limited time available to conduct the assessment, 13 DOE reactors were of such size (physical, power or fission product inventory) to warrant review. This determination was approved by the Under Secretary. A decision was also made in the cases of three weapons material production reactors, C, K and P, to concentrate on the K reactor only, since all three are of the same basic design, have the same operating features, are all at the same site, and are all operated by the same contractor. The assessment was accomplished in the following ways: reviewing the results of assessments conducted by the DOE organizations with reactor safety responsibilities, which were undertaken in compliance with the request of the various program directors; reviewing selected documents that were requested by the Committee and assembled at DOE Headquarters; interviewing DOE Headquarters and Field Office personnel; and conducting on-site reviews of four reactors located at four different sites. The four reactors for on-site reviews were: Advanced Test Reactor (ATR); K Production Reactor; High Flux Beam Reactor (HFBR); and High Flux Isotope Reactor (HFIR). Specific findings and recommendations from the assessment are presented.

28732 **(EGG-M—02281) Selected monitoring practices.** Rich, B.L. (EG and G Idaho, Inc., Idaho Falls (USA)). 1981. Contract AC07-76ID01570. 44p. NTIS, PC A03/MF A01. Order Number DE81028273.

This paper covers, in general terms, a discussion of considerations in monitoring and controlling radiation hazards in a nuclear plant. The following areas are discussed: (1) types of fields encountered from fission and activation products, neutron fields, and others with implications; (2) related considerations such as calibration sources, emergency conditions, ALARA; (3) portable survey instrument considerations as they apply to monitoring; (4) personnel dosimetry, limitations and considerations; (5) field control principles; and (6) effluent evaluation considerations.

28733 **(EPRI-NP—1856Vols1,2,3) Numerical simulation of BWR suppression pool dynamics. Final report.** Hirt, C.W.; Nichols, B.D.; Stein, L.R. (Los Alamos National Lab., NM (USA)). Jun 1981. Contract W-7405-ENG-36. 194p. NTIS, PC A09/MF A01. Order Number DE81026299.

Pressure suppression pools used in nuclear reactors are subject to hydrodynamic processes involving complicated free-surface configurations. A new numerical method developed to handle such problems, SOLVA-VOF, is described and evaluated through comparisons with laboratory test data. The method has been utilized to analyze the Mark II single-cell model in experiments at SRI International. Calculations show the sensitivity of the results to variations in the water vapor content, vent submergence depth, and vent orifice size, and to the effect of fluid-structure interaction. A simple modificaton is described that may be used to add limited compressibility effects to incompressible hydrodynamic computer codes. General utility of the developed method has been demonstrated by application to the analysis of the steam chugging phenomenon, the horizontal vent-clearing process, the effects of internal obstacles, and the three-dimensional effects on pool dynamics.

28734 **(GEAP—25163-4) Demonstration of fuel resistant to pellet-cladding interaction: Phase 2. Fourth semiannual report, July-December 1980.** Rosenbaum, H.S. (comp.). (Commonwealth Research Corp., Chicago, IL (USA)). Mar 1981. Contract AC02-77ET34001. 75p. NTIS, PC A04/MF A01. Order Number DE81026958.

This program has as its ultimate objective the demonstration of an advanced fuel design that is resistant to the failure mechanism known as fuel pellet-cladding interaction (PCI). Two fuel concepts have been developed for possible demonstration: (a) Cu-barrier fuel and (b) Zr-liner fuel. These advanced fuels (known collectively as barrier fuels) have special fuel cladding designed to avoid the harmful effects of localized stress and reactive fission products during reactor service. Within the scope of this program one of these concepts had to be selected for a large-scale demonstration in a commercial power reactor. The selection was made to demonstrate Zr-liner fuel and to include bundles which have liners prepared from either low oxygen sponge zirconium or of crystal bar zirconium. The demonstration is intended to include a total of 132 barrier bundles in the reload for Quad Cities Unit 2, Cycle 6. In the current report period changes in the nuclear design were made to respond to changes in the Energy Utilization Plan for Quad Cities Unit 2. Bundle designs were completed, and were licensed for use in a BWR/3. The core specific licensing will be done as part of the reload license for Quad Cities Unit 2, Cycle 6.

28735 **(GEND—010(Vol.2)) In-vessel inspection before head removal: TMI II, Phase II (tooling and systems design).** Greenlee, D.W. (EG and G Idaho, Inc., Idaho Falls (USA); Babcock and Wilcox Co., Lynchburg, VA (USA)). Jul 1981. Contract AC07-76ID01570. 122p. NTIS, PC A06/MF A01. Order Number DE81026957.

Since the events at the Three Mile Island Nuclear Station (Unit II) on March 28, 1979, there has been much analysis and speculation as to the condition of the reactor core. The purpose of the In-Vessel Inspection Before Head Removal project is to provide a video inspection of the reactor internals, including the tops of some of the fuel assemblies. This early look will be a data point and serve to guide the rest of the reactor disassembly program. The inspection will be accomplished by lowering a video camera through a Control Rod Drive Nozzle and manipulating it around the plenum and down to the top of the reactor core.

28736 **(GEND-INF—003) Quick look report, Entry 3: Three Mile Island Unit 2, October 16, 1980.** (EG and G Idaho, Inc., Idaho Falls (USA)). Jul 1981. 34p. NTIS, PC A03/MF A01. Order Number DE81028758.

This report summarizes tasks performed during the third entry at Three Mile Island Unit 2. During the entry into containment, which was made on October 16, 1980, additional beta, gamma, and neutron surveys were performed to supplement data obtained on previous entries. In addition, several maintenance tasks were completed including testing the operation of both equipment hatch doors, replacing a loose parts monitor system pre-amplifier, and removing a source range monitor. The five-man entry team accomplished these tasks in about 1-1/2 hours.

28737 **(PNL—3511) LMFBR conceptual design study: an overview of environmental and safety concerns.** Brenchley, D.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1981. Contract AC06-76RL01830. 108p. NTIS, PC A06/MF A01. Order Number DE81028260.

The US Department of Energy (DOE) initiated the Liquid Metal Fast Breeder (LMFBR) Conceptual Design Study (CDS) with the objective of maintaining a viable breeder option. The project is scheduled to be completed in FY-1981 but decisions regarding plant construction will be delayed until at least 1985. This report provides a review of the potential environmental and safety engineering concerns for the CDS and recommends specific action for the Environmental and Safety Engineering Division of DOE.

28738 **(SAND—81-1533C) LWR meltdown analyses and uncertainties.** Rivard, J.B.; Haskin, F.E. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 32p. (CONF-810803—8). NTIS, PC A03/MF A01. Order Number DE81025832.

From Topical meeting on reactor safety aspects of fuel behavior; Sun Valley, ID, USA (2 Aug 1981).

The forthcoming rulemaking poses significant questions concerning the behavior of LWR fuel during accidents beyond the design bases. These questions cannot readily be addressed based upon experiment results which are currently projected to become available within the rulemaking time frame. Analyses based on available computer codes and experimental data have yielded new

insights into the progression of in-vessel fuel degradation and materials redistribution during LWR meltdown accidents. Phenomenological and modeling uncertainties have been identified together with potential destabilizing mechanisms during both unperturbed meltdown sequences and sequences involving reflooding. Specific issues of greatest relative importance have been identified which sharpen the focus of efforts to quantify and reduce the uncertainties.

28739 **(UCRL—85707Rev.1) Method for chug classification.** McCauley, E.W.; Weaver, H.J.; Altenbach, T.J. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Apr 1981. Contract W-7405-ENG-48. 38p. (CONF-810643—1(Rev.1)). NTIS, PC A03/MF A01. Order Number DE81028686.

From 1. international specialists meeting on BWR-pressure suppression containment technology; Geesthacht, F.R. Germany (1 Jun 1981).

A method is presented which classifies the late time condensation phenomena of chugging as it occurs in pressure suppression tests. The method uses a five (5) character letter code which describes both the spectral (frequency) and temporal characteristics of a chug event.

25 ENERGY STORAGE

2502 Compressed Gas

28740 **(PNL—3862) Legal and regulatory issues affecting compressed air energy storage.** Hendrickson, P.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1981. Contract AC06-76RL01830. 75p. NTIS, PC A04/MF A01. Order Number DE81028263.

Several regulatory and legal issues that can potentially affect implementation of a compressed air energy storage (CAES) system are discussed. This technology involves the compression of air using base load electric power for storage in an underground storage medium. The air is subsequently released and allowed to pass through a turbine to generate electricity during periods of peak demand. The storage media considered most feasible are a mined hard rock cavern, a solution-mined cavern in a salt deposit, and a porous geologic formation (normally an aquifer) of suitable structure. The issues are discussed in four categories: regulatory issues common to most CAES facilities regardless of storage medium, regulatory issues applicable to particular CAES reservoir media, issues related to possible liability from CAES operations, and issues related to acquisition of appropriate property rights for CAES implementation. The focus is on selected federal regulation. Lesser attention is given to state and local regulation. (WHK)

2505 Flywheels

REFER ALSO TO CITATION(S) 28933

28741 **(UCRL—15365Vol.1) Flywheel materials technology: design data manual for composite materials.** Hahn, H.T.; Hwang, D.G.; Cheng, H.C.; Lo, S.Y. (Lawrence Livermore National Lab., CA (USA); Washington Univ., St. Louis, MO (USA)). Jul 1981. Contract W-7405-ENG-48. 238p. NTIS, PC A11/MF A01. Order Number DE81027020.

Compiled in this manual are data on thermomechanical properties of unidirectional composites. The data were taken from open literature and government reports. The primary objective of this manual is to provide the material property data necessary for design of flywheels using modern composite materials. However, the manual will be helpful for any design with composites where structural performance is a major concern. Some preliminary information necessary for an effective use of this manual is given. The characterization of strength and fatigue properties and the hygrothermal properties of composite materials are described briefly. Material properties according to the type of composite are presented. Listed for each composite system is information on constituent materials, cure cycle, preconditioning, test environment, sources of data, and test methods used. The material properties include elastic moduli, strengths, fatigue properties, and hygrothermal properties.

28742 **(UCRL—15366) Flywheel test facility improvement program. Final report, March 21, 1980-February 28, 1981.** Rabenhorst, D.W.; Wilkinson, W.O. (Lawrence Livermore National Lab., CA (USA); Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). Feb 1981. Contract W-7405-ENG-48. 111p. NTIS, PC A06/MF A01. Order Number DE81026563.

The procurement designs for a new flywheel test facility having the capability of high speed life cycle testing of flywheels up to 5 kWh and of burst testing flywheels up to 50 kWh are reported. The following goals were achieved: (1) the overall facility design was completed in sufficient detail that procurement could proceed on all items; (2) drive trains were defined which would allow spin testing of flywheels of up to 200 lbs at rotational speeds up to 60,000 rpm, or flywheels weighing up to 5000 lbs at rotational speeds up to 10,000 rpm; (3) vacuum chambers and burst containment systems were designed to accommodate flywheels up to 65 in. in diameter and 62 in. in axial length, and weights up to 5000 lbs at an energy level of 50 kWh; (4) suspension systems were designed to permit flywheels up to either 5 kWh or 50 kWh to be tested over the complete range of available rotational speeds without encountering damaging resonances; (5) existing APL facilities and equipment, such as control console, instrumentation, vacuum equipment, air compressors, drive trains, handling equipment, and the flywheel test facility were integrated into the new test facility designs; (6) a high speed television recording system was defined which will enable the continuous monitoring of flywheel tests at 960 frames per second; and (7) actual manufacturers quotations and projected schedules for procurement were obtained on all critical items for the new facility.

28743 **(UCRL—86297) Mechanical energy storage technology project.** Barlow, T.M. (Lawrence Livermore National Lab., CA (USA)). 22 Jun 1981. Contract W-7405-ENG-48. 8p. (CONF-810833—1). NTIS, PC A02/MF A01. Order Number DE81026800.

From Mechanical, magnetic, and underground energy storage 1981 annual contractors' review meeting; Washington, DC, USA (24 Aug 1981).

The Mechanical Energy Storage Technology Project at the Lawrence Livermore National Laboratory exercises field technical management of the Department of Energy's flywheel technology program. This paper summarizes the objectives, approaches, structure, and principal accomplishements of the Project during FY 1981. It also summarizes efforts in international flywheel-related technology and complementary efforts in the United States.

2506 Thermal

REFER ALSO TO CITATION(S) 28503, 28504

28744 **(ANL—81-45) First annual workshop on ice storage for cooling applications, Argonne National Laboratory, June 4-5, 1981.** Gorski, A.J. (comp.). (Argonne National Lab., IL (USA)). Jul 1981. Contract W-31-109-ENG-38. 39p. NTIS, PC A03/MF A01. Order Number DE81025984.

The papers presented at the first annual workshop on ice storage for cooling applications by participants from the US and Canada are summarized. Novel methods of preparing naturally frozen ice and storing it are described. Attention is given to technical and economic problems and related design considerations. Comparison is made with conventional air conditioning methods. Both industrial and residential applications are discussed with regard to cost.

28745 **(BNL—29592) Chemical heat pump program: an overview.** Mezzina, A. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 5p. (CONF-810672—22). NTIS, PC A02/MF A01. Order Number DE81025086.

From DOE heat pump contractors' program integration meeting; McLean, VA, USA (2 Jun 1981).

Program background, rationale, technology description, and research and development needs are addressed. Chemical heat pumps comprise reversible reactions which can be driven by low-

grade heat. Thermal energy is absorbed in one direction and liberated in the reverse direction; thus, serving as a basis for system designs applicable to space conditioning or process heat management and offering the capability for high-density energy storage as an integral part of the system.

28746 (DOE/CS/40004—T10) Thermal energy storage market-oriented background paper. (TRW Systems Group, McLean, VA (USA)). 15 Jun 1977. Contract AC03-77CS40004. 22p. NTIS, PC A02/MF A01.

Thermal energy storage (TES) technologies and their applications are discussed. The markets and commercialization status and potential are explored. ERDA TES program plans are presented. It is concluded that the only TES systems ready for immediate commercialization are storage water heating and space heating charged with off-peak electricity. All that is needed for commercialization to occur is the introduction of appropriate split electricity rates or load management contracts. In the near-term, solar water heating and space heating, electric utility TES and TES space cooling with off-peak electricity may prove economic. Technology for these systems is available now or will be soon. The most promising of these is TES space cooling for commercial buildings where the economies of scale may make the systems very attractive. Again, electric rate structures must be altered for commercialization to occur. Increasing energy costs and tax incentives will help commercialize solar systems. The systems also must be proven reliable and performance accurately predicted for general market acceptance to occur. More research must be done on seasonal storage, industrial uses of TES, heat battery powered vehicles and solar thermal power for electrical generation to determine their commercial potential. Of these, current estimates for heat vehicles are the most promising, although a prototype has not yet been built and the concept must await development of the Stirling engine. If industrial and agricultural use of TES are shown to be economic, there should be no problems with commercialization as this sector is very cost conscious and tends to have available capital. Solar thermal power for electrical generation does not look economical currently, but needs further study as an inexhaustible energy source.

28747 (DOE/ET/20195—T1(Vol.2)) Advanced thermal energy storage concept definition study for solar Brayton power plants. Volume II. Thermal energy storage system sizing computer program, July 1-December 31, 1976. Gintz, J.R. (Boeing Co., Seattle, WA (USA); Boeing Engineering and Construction Co., Seattle, WA (USA). Energy and Environment Div.). 1976. Contract AC03-76ET20195. 101p. NTIS, PC A06/MF A01. Order Number DE81026120.

This document describes the computer program used in conceptual studies of phase change and sensible heat thermal energy storage systems. The model assumes the phase change media is contained in a tube-in-bath configuration. The sensible heat medium is contained in high pressure tanks. The program has been used in conjunction with, but is not necessarily limited to, a high temperature, gas-cooled solar power plant. The program represents a computer implementation of the engineering equations used to estimate the size and cost of a given thermal storage system design concept. A description of the model including a description of the inputs and outputs of the program is presented.

2508 Chemical

REFER ALSO TO CITATION(S) 28745, 28847

2509 Batteries

REFER ALSO TO CITATION(S) 28924, 28926, 28926, 28927

28748 (ANL/OEPM—81-3) Annual synopsis of Battery Support Research, fiscal year 1980. Cook, G.M. (comp.). (Argonne National Lab., IL (USA)). May 1981. Contract W-31-109-ENG-38. 39p. NTIS, PC A03/MF A01. Order Number DE81026473.

The present activities are ultimately directed at improving the performance of lead-acid, Ni/Zn, and Ni/Fe batteries, especially those for electric vehicle or utility load-leveling applications. In addition to short descriptions of each of the projects (lead-acid and nickel/zinc battery studies, battery modeling, and analysis and evaluation projects), summaries of work published or presented during the year are included.

28749 (CONF-800612—5) Lithium/iron sulfide cell development for electric-vehicle propulsion. Gay, E.C.; Miller, W.E.; Kolba, V.M.; Shimotake, H. (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG-38. 15p. NTIS, PC A02/MF A01. Order Number DE81023570.

From 29. power sources conference; Atlantic City, NJ, USA (9 Jun 1980).

the lithium/iron sulfide battery development at Argonne National Laboratory (ANL) is primarily concerned with the development of high-performance, secondary batteries for electric vehicle propulsion. The program on the electric-vehicle battery involves the development, design, and fabrication of a series of full-scale lithium/metal sulfide batteries, designated Mark IA, II, and III. A status report on the cell development for this program is given. These cells consist of a lithium-aluminum (Li-Al) negative electrode, an FeS positive electrode and molten LiCl-KCl electrolyte. The melting point of the electrolyte requires a cell operating temperature in the range of 400-500°C. The cells that have been fabricated during the past year have been of a prismatic design and most of the cells contained either boron nitride (BN) fabric separator with yttria felt particle retainer or BN felt which served as both the electrode separator and particle retainer. A few cells were tested with ceramic powder separators. Bicell designs with one positive electrode and facing negative electrodes or multiplate designs with two or more positive electrodes were used. Test results are presented and discussed. (WHK)

28750 (CONF-800804—42) Development and evaluation of BN felt as separator materials. Swaroop, R.B.; Battles, J.E.; Hamilton, R.S. (Argonne National Lab., IL (USA); Kennecott Development Corp., Niagara Falls, NY (USA)). 1980. Contract W-31-109-ENG-38. 12p. NTIS, PC A02/MF A01. Order Number DE81024256.

From ASME century 2 emerging technology conference; San Francisco, CA, USA (10 Aug 1980).

Electrode separators are being developed and evaluated for use in high-temperature Li-Al/MS secondary batteries. Boron nitride fabric has been used as the separator material in most Li-Al/MS cells fabricated thus far. However, BN felt separators are presently under development because they are potentially less expensive and more porous than the BN fabric separators. As a preliminary evaluation, the physical properties of various BN felts were determined. Subsequently, felts were also tested in experimental cells operated for extended periods (>1000 hr). The tests indicated that the BN felt is suitable for use in cells.

28751 (CONF-8008118—1) Recent advances in lead-acid cell research and development. Voss, E. (Argonne National Lab., IL (USA); Varta Batterie A.G., Kelkheim (Germany, F.R.). Forschungs- und Entwicklungszentrum). 1980. Contract W-31-109-ENG-38. 38p. NTIS, PC A03/MF A01. Order Number DE81023104.

From EVA '80 conference; Adelaide, Australia (25 Aug 1980).

The lead-acid battery still is and will be for the foreseeable future the most widely used secondary energy storage system. It will maintain this predominant role because of its highly developed technology, its low costs as compared to other secondary systems and its high reliability. During the last decade it has been demonstrated that the lead-acid system is capable of providing an attractive energy source of sufficient energy and power per unit weight and volume which allows its successful application for electric vehicle propulsion. Basic research has contributed in a worldwide effort to the improvement of active material utilization and cycle life as well. This is shown by a number of typical examples, such as the relationship between active material properties and capacity at high rates of discharge, the effect of acid stratification and others. Simultaneously, the expenditure for the maintenance of lead-acid batteries has been minimized by the development of peripheric equipment, as there are means for central-automatic water refill and recombination devices. It is shown that there is still a considerable potential for further improvement which might again strengthen

the unique position of the lead-acid system in the market in comparison to competitive systems.

28752 **(DOE/ER/04445—T2) Activity and diffusion of metals in binary aluminum alloys.** Jao, C.S. (Illinois Inst. of Tech., Chicago (USA)). Dec 1980. Contract AS02-77ER04445. 77p. NTIS, PC A05/MF A01. Order Number DE81025535.

To determine the activity of zinc in Zn-Al alloys, the electromotive force (emf) of the cell: $Zn/ZnCl_2$-KCl (eut)/Zn,Al was measured at temperatures between 569.5 K (296.5C) and 649.5 K (376.5C). The applicability of a two-suffix Margules equation was demonstrated, in good agreement with theoretical expectations. The diffusion coefficient of Zn in Al determined from a planar diffusion model for the experimental data was about 3×10^{-10} cm²/sec to 2×10^{-9} cm²/sec in the range of temperature studied. This is higher than that found in the literature. The most plausible reason appears to be the high alumina concentration in the working electrode because of partial oxidation. Oxidation of the alloying metals was the primary cause of poor alloying between calcium/or zinc and aluminum, thereby frustrating similar measurements at a Ca-Al/or Zn-Al alloy. The literature on the activity of calcium and zinc is aluminum is reviewed.

28753 **(LBL—11090) Rechargeable molten-salt cells.** Cairns, E.J. (Lawrence Berkeley Lab., CA (USA)). Oct 1980. Contract W-7405-ENG-48. 23p. (CONF-8010159—12). NTIS, PC A02/MF A01. Order Number DE81027091.

From Fall meeting of the Electrochemical Society; Hollywood, FL, USA (5 Oct 1980).

Rechargeable molten-salt cells offer the opportunity for achieving higher specific energy than is available from ambient-temperature cells (200 W-h/kg), and a specific power in excess of 100 W/kg. Two main types of rechargeable cells employing molten salts are being developed: those with a molten salt as the sole electrolyte, and those with a combination of a solid electrolyte and a molten salt electrolyte. The status, recent research, and current problems for each of several systems in the above two categories are discussed. The most advanced systems in the first category are Li/Al/FeS and Li_4Si/FeS_2; in the second category, $Na/Na_2O\ xAl_2O_3/S$ is the most advanced system. Interesting new cells continue to be proposed, having special features that may justify development. Overall, rechargeable molten-salt cells are making good progress. The main generic problems requiring additional work include corrosion-resistance current collectors and seals, ceramic electrolytes that resist degradation and thermal cycling, inexpensive corrosion-resistant porous separators, and improved electrode designs.

28754 **(LBL—12690) Overview of the applied battery and electrochemical research program.** McLarnon, F. (Lawrence Berkeley Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 15p. (CONF-810642—5). NTIS, PC A02/MF A01. Order Number DE81027397.

From 4. DOE battery and electrochemical contractor's conference; Washington, DC, USA (2 Jun 1981).

The Lawrence Berkeley Laboratory (LBL) has lead mission responsibility for the Applied Battery and Electrochemical Research Program. The purpose of this program is to provide the applied research base which supports all of DOE's Electrochemical Systems Missions, and the general objective is to help provide batteries and electrochemical systems that can satisfy economic, performance and schedule requirements. The specific goal is to identify the most promising electrochemical technologies and transfer them to industry and/or another DOE program for further development and scale-up. The research program is described. (WHK)

28755 **(UCRL—15354) Production of anodes for aluminum-air power cells directly from Hall cell metal.** McMinn, C.J.; Branscomb, J.A. (Reynolds Aluminum, Sheffield, AL (USA). Reduction Research Div.). 12 Feb 1981. Contract W-7405-ENG-48. 27p. NTIS, PC A02/MF A01. Order Number DE81026570.

The feasibility of producing aluminum anode plates for an aluminum-air power cell directly from primary aluminum as produced in Hall cells was examined, and costs for these anode plates were estimated. A critical assumption for this part of the study was that aluminum anode plates of alloy composition, 0.4 to 0.8% Mn, 0.04% Fe, and 0.04% Ga, with minor impurities normally occurring in 5A and 6A grade primary aluminum, would be satisfactory for power cell application. It is feasible to produce the above alloy in Hall cells and to go directly to 10- to 12-mm-thick anode slabs using a continuousy moving mold caster such as the Scal Jumbo. An aluminum alloy containing 0.4 to 0.8% Mn, 0.04% Fe, and 0.04% Ga can be produced in an aluminum plant specializing in high-purity metal production. The anodes produced by the processes described would cost 15 cents/lb over 3A grade molten aluminum costs (3.5 cents/lb for premium purity. 2.4 cents/lb for alloying agents, and 9.0 cents/lb for casting and shearing). Anodes could be produced with 0.03% Fe using Hall cell metal and continuous casting by the use of specially prepared aluminas, such as some chemical grade products. This would add another 10 to 15 cents/lb to the cost, over the 15 cents/lb described above. It is not feasible to produce lower iron anodes directly from Hall cell metal. (WHK)

29 ENERGY PLANNING AND POLICY

28756 **(DOE/CR—0022) FY 1982 budget in brief.** (Department of Energy, Washington, DC (USA). Office of the Controller). Mar 1981. 63p. NTIS, PC A04/MF A01. Order Number DE81027875.

The Department of Energy's budget request for FY 1982 supports a set of energy programs carefully structured to be consistent with the imperative need to control federal spending, the proper role of the federal government in energy research and development, and the superiority of the free market to allocate resources efficiently. In addition to its mission in the energy area, the Department also has major responsibilities for preparing for future petroleum emergencies and for the conduct of general science and national defense activities. Although the national defense and general science activities do not directly support our energy R and D mission, advancements in scientific knowledge and technology development in these areas contribute indirectly to energy research and development. The budget request is summarized.

28757 **(ORNL/CON—76) Evaluation of conservation programs: a primer.** Soderstrom, E.J.; Berry, L.G.; Hirst, E.; Bronfman, B.H. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 95p. NTIS, PC A05/MF A01. Order Number DE81027679.

This primer is an introduction to the field of program evaluation. A considerable amount of information is included about the actual conduct of an evaluation. No specific activity is addressed, but rather an idea is provided of the issues and constraints characteristic of each phase and activity of an evaluation. Examples of how these issues arise and potential solutions are presented. Chapter 1 provides background on the origins and evolution of evaluation, focusing especially on why evaluation is currently receiving increased emphasis. Chapter 2 is an overview of the field of evaluation, especially as it relates to energy conservation. Chapter 3 is a consideration of the steps involved in conducting an evaluation from the planning stage to data analysis. Chapter 4 discusses managerial considerations in conducting an evaluation. Chapter 5 discusses evaluators as people; both in terms of organizational obstacles likely to be encountered by, and personal characteristics found in, good evaluators. An appendix includes suggested further readings.

28758 **(SAND—81-1750C) Overview of Sandia National Laboratories: present and future.** Winter, C. (Sandia National Labs., Albuquerque, NM (USA)). 23 Jul 1981. Contract AC04-76DP00789. 10p. (CONF-810735—1). NTIS, PC A02/MF A01. Order Number DE81027252.

From Albuquerque Home Builders Association meeting; Albuquerque, NM, USA (23 Jul 1981).

The history and research activities of Sandia National Laboratories are summarized in this lecture. Weapons design responsibilities are briefly discussed. The new role taken on by the laboratory in the field of energy is also discussed.

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 28153, 28851, 28867, 28869, 28880, 28886, 28901, 28913, 28916

28759 Overview and special features of the time-stepped Energy-System-Optimization Model (TESOM). Kydes, A.S.; Rabinowitz, J. (Brookhaven National Lab., Upton, NY). *Resources and Energy ;* **3**: No. 1, 65-92(Mar 1981).

This paper describes the TESOM which is the principal time-dependent energy-integrating model used at Brookhaven National Laboratory for energy-systems analysis. Special control theoretic features which act to smooth the intertemporal transitions between time periods are highlighted. These features include a market-penetration adjustment algorithm, an explicit representation of the technological and cost behavior of inherited (vintaged) stock, and the incorporation of risk factors in resource pricing. 10 references, 10 figures.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 28790, 28792, 28793, 28794, 28800, 28801, 28814, 28824, 29257

28760 (DOE/PE—0030) Interrelationships of energy and the economy: a supplemental to the National Energy Policy Plan required by Title VIII of the US Department of Energy Organization Act (Public Law 95-91). (USDOE Office of Policy, Planning and Analysis, Washington, DC). Jul 1981. 70p. NTIS, PC A04/MF A01. Order Number DE81027526.

The Department of Energy (DOE) is directed by Title VIII of the National Energy Policy Plan to evaluate periodicially the effects of current and projected energy trends on the economic health of the Nation. This study developed a fairly wide range of estimates for the impact of energy prices on such key variables as real gross national product, inflation, and the US trade balance. The retrospective analysis suggests that potential economic output in the near future is being affected adversely by such energy-price results from the recent past as lower investment, reduced labor force participation, slower growth in labor productivity, and reduced access to real energy resources. Policies that seek to stimulate the supply side of the economy (including policies that seek to stimulate the specific development of energy resources) are directed at offsetting such past effects. 1981-90 projections are presented of the impacts upon the economy in the three energy price scenarios developed in the document Energy Projections to the Year 2000. These projections show a range of impacts from alternative levels of energy prices upon each major component of the economy. Additional longer term projections for similar energy price scenarios are also made and analyzed. Finally, the projected impact of projected increases in energy prices on various economic groups is summarized by estimating changes in direct household energy expenditures - according to income, by regional location, and by rural-versus-urban residence. Special attention is given to projected impacts on low-income households and on the elderly. Significant differences of opinion remain among experts about the degree of energy's influence on economic growth, price stability, and, especially, productivity. However, it is hoped that the research reported here, along with continuing efforts, will enlarge the understanding of energy-economy interrelationships.

28761 (ORNL/TM—7641) Long-term projections of population and employment for regions of the United States (TOPS2.R2.OBERS80). Herzog, H.W. Jr.; Bjornstad, D.J.; Stuckwish, D.N. (Oak Ridge National Lab., TN (USA)). Aug 1981. Contract W-7405-ENG-26. 531p. NTIS, PC A23/MF A01. Order Number DE81025966.

This volume presents updated projections of population and employment for census regions, federal regions, states, and Bureau of Economic Analysis economic areas prepared using the MULTIREGION system. These projections are based upon a national scenario comprising Census Series II demography and Bureau of Economic Analysis employment growth rates. Data for the years 1950, 1960, 1970, 1985, 1990, and 2000 are presented with population detail for 20 age/sex cohorts and employment detail for 31 sectors.

28762 (PNL—3788-Exec.Summ.) Comparison of the incentives used to stimulate energy production in Japan, France, West Germany, and the United States. Cole, R.J.; Cone, B.W.; Sommers, P.; Eschbach, C.; Sheppard, W.J.; Lenerz, D.E.; Huelshoff, M.; Marcus, A.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1981. Contract AC06-76RL01830. 22p. NTIS, PC A02/MF A01. Order Number DE81025767.

The conclusions of each of three previous non-US incentives volumes and the conclusions of the comparisons volume which looks at incentives in four countries including the United States are summarized. Summaries of the patterns of incentive actions in France, West Germany, and Japan are presented first, followed by a summary of the four-country comparisons volume itself. Suggestions for solar policy which are based on the comparison of incentive actions in the four countries are presented. The definitions and methods used in each of the single-country studies are explained in detail in those volumes. A brief explanation of the procedures is offered. Each volume was divided into three parts: a survey of current thought about incentives for solar energy production; a view of the energy incentive landscape for one particular year; and an analysis of the major energy forms (nuclear, hydro, coal, electricity, oil, and gas) along the path from exploration to waste management, including the costs of incentives at each step in constant national currency. Following the theoretical approach developed for studying US energy incentives, the researchers in each country classified incentives into the following six categories: taxation, disbursements, requirements traditional services, nontraditional services, and market activities.

28763 (PNL—3863) Impact of recent energy legislation on the aluminum industry. Edelson, E.; Emery, J.G.; Hopp, W.J.; Kretz, A.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1981. Contract AC06-76RL01830. 54p. NTIS, PC A04/MF A01. Order Number DE81027519.

This report examines the aluminum industry's technology in energy use and emissions control. Data on consumption and pollution levels are presented. A history of the aluminum industry in the Pacific Northwest, its role in providing power reserves, and how that role fits into the present power situation are given. The Northwest Power Act, the rates the industry will probably pay as a result of the Act, the implications of those rates to the industry, as well as the availability of federal power to the industry are discussed. Finally, the Act's effects on the relative competitiveness of the industry in both domestic and world markets are examined.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 28791, 28882, 29258

28764 (CONF-810814—3) Safety analysis and review system: a Department of Energy safety assurance tool. Rosenthal, H.B. (Department of Energy, Washington, DC (USA)). 1981. 28p. NTIS, PC A03/MF A01. Order Number DE81026090.

From 91. national meeting of the American Institute of Chemical Engineers; Detroit, MI, USA (16 Aug 1981).

The concept of the Safety Analysis and Review System is not new. It has been used within the Department and its predecessor agencies, Atomic Energy Commission (AEC) and Energy Research and Development Administration (ERDA), for over 20 years. To minimize the risks from nuclear reactor and power plants, the AEC developed a process to support management authorization of each operation through identification and analysis of potential hazards and the measures taken to control them. As the agency evolved from AEC through ERDA to the Department of Energy, its responsibilities were broadened to cover a diversity of technologies, including those associated with the development of fossil, solar, and geothermal energy. Because the safety analysis process had proved effective in a technology of high potential hazard, the Department investigated the applicability of the process to the other technologies. This paper describes the system and discusses how it is implemented within the Department.

28765 **(DOE/EP—0021) Environmental trends to the year 2000.** (Department of Energy, Washington, DC (USA)). Jul 1981. 23p. NTIS, PC A02/MF A01. Order Number DE81027695.

This analysis focuses on the environmental impacts of the National Energy Policy Plan and emphasizes those pollutants for which energy development and use play a significant role. Energy is by no means responsible for all the increases projected for the various emissions. The increase in relative contributions of the energy sector to emissions during the study period is within a range of zero to 15% for all selected pollutants with the exception of ash, captured particulates, and oil-shale waste. For that group, the energy sector contribution increases from 58% to 89%, primarily because of the production of oil from shale. If the oil-shale wastes were not included in these totals, energy-process wastes would be 62% of the national total of 250 million tons. Even though these figures represent total net emissions to the environment, rather than ambient concentrations, the assessment offers a sound basis for an important overall conclusion. The significant economic growth projected by the National Energy Policy Plan, and continuing free-market efforts to ensure the wise and efficient application of energy resources by the nation, can be achieved without foresaking reasonable environmental quality.

28766 (EPA—600/9-81-019a, pp 27-47) **Nation's energy future: with focus on synfuels.** Princiotta, F.T. (Environmental Protection Agency, Washington, DC). Apr 1981. NTIS.

From Symposium on flue gas desulfurization; Houston, TX, USA (28 Oct 1980).

Projections indicate that coal, nuclear energy and oil shale will become increasingly important as we adjust for static domestic oil and gas production and minimization oil importation. Environmental problems can be quite severe for each of these fuel cycles. A massive synthetic fuel industry based on coal, oil shale and biomass, is emerging with monumental potential for environmental damage. The Environmental Protection Agency (EPA) has designed a regulatory program aimed at mitigating environmental damage while allowing for birth and nurturing of this critical industry.

28767 **(LBL—12779) Integrated assessment for energy-related environmental standards: a summary of issues and findings.** Holdren, J.P. (Lawrence Berkeley Lab., CA (USA)). Oct 1980. Contract W-7405-ENG-48. 60p. NTIS, PC A04/MF A01. Order Number DE81028552.

This report summarizes the findings of a 30-month research effort, the Project on Integrated Assessment for Energy-Related Environmental Standards, conducted for the Office of Environmental Assessments, Office of Environment, US Department of Energy, by a team of faculty and graduate-student researchers associated with the Energy and Resources Group of the University of California, Berkeley, and the Energy and Environment Division of the University's Lawrence Berkeley Laboratory. 70 references.

28768 **Ecological study of human settlements.** Boyden, S. (Australian National Univ., Canberra). *Nature and Resources ;* **16**: No. 3, 2-9(Jul 1980).

The underlying philosophy behind the Man and Biosphere Program is detailed, with aims, objectives and methodological approaches given. (PSB)

28769 **(SAND—81-0635) Guidance for implementing an environmental, safety and health assurance program. Volume 4. Model plan for institutional emergency response programs.** Ellingson, A.C.; Gunderson, E.L. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1981. Contract AC04-76DP00789. 46p. NTIS, PC A03/MF A01. Order Number DE81027480.

This is 1 of 15 documents designed to illustrate how an Environmental, Safety and Health (ES and H) Assurance Program may be implemented. The generic definition of ES and H Assurance Programs is given in a companion document entitled An Environmental, Safety and Health Assurance Program Standard. This document presents a model emergency response program which may be used as a guide for developing an institutional program plan that conforms to the requirements to the Program Standard.

28770 **(SAND—81-0639) Guidance for implementing an environmental, safety and health assurance program. Volume 8. Model guidelines for line organization environmental, safety and health committee operations.** Ellingson, A.C.; Trauth, C.A. Jr.; Jercinovic, L.M. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1981. Contract AC04-78DP00789. 33p. NTIS, PC A03/MF A01. Order Number DE81027483.

This is 1 of 15 documents designed to illustrate how an Environmental, Safety and Health (ES and H) Assurance Program may be implemented. The generic definition of ES and H Assurance Programs is given in a companion document entitled An Environmental, Safety and Health Assurance Program Standard. The Standard specified that each operational level of an institution must have an internal assurance function performed by a group or individual with sufficient independence to objectively evaluate that level's ES and H program. This document shows how the internal assurance function may be performed by an ES and H Committee.

28771 **Eutrophication control.** Vollenweider, R.A. *Nature and Resources ;* **16**: No. 3, 9-14(Jul 1980).

Man-made accelerated eutrophication of waters has been developing rapidly over the past two decades, particularly in industrialized countries. Since 1967, the Organization for Economic Co-operation and Development has been studying this problem, and co-operative action among the Member Countries of this organization since 1970 culminated in a Co-operative Monitoring Program of Inland Waters (lakes and reservoirs) under the chairmanship of Dr. Vollenweider. The data and knowledge gathered under this program has been drawn together into a synthesis report, whose conclusions and recommendations are summarized here. The importance of the eutrophication problem for all countries - including developing countries to an increasing degree - is such that Unesco intends to consider it closely. The results and methods used in the OECD study will be brought to the attention of scientists and decision-makers all over the world, and its results compared with those obtained in other studies. The contribution of OECD is gratefully acknowledged.

28772 **World Conservation Strategy.** *Nature and Resources ;* **16**: No. 3, 2-4(Jul 1980).

The World Conservation Strategy defines living resource conservation and explains its objectives, its contribution to human survival and development and the main impediments to its achievement; determines the priority requirements for achieving each of the objectives; and proposes national and subnational strategies to meet the priority requirements, describing a framework and principles for those strategies.

2904 Natural Resources

REFER ALSO TO CITATION(S) 28818, 29254

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 28106, 28584, 28585, 28806, 28898

28773 **Technology transfer and international law.** Nanyenya-Takirambudde, P. New York, NY; Praeger Publishers (1980). 188p.

Controversy surrounding technology transfer to developing countries reflects the need to evaluate transfer policies in such a way that the political and economic implications of alternative strategies are considered. A thorough study of historical power relationships as well as the legal ramifications should guide policy-makers. This review of technology-transfer issues analyzes the split between those industrialized areas that claim exclusive use of inventions and the counterclaims by those in the Third World who want easier access to technology and who want that access to be recognized as an inherent right. Disparity in the global distribution of technology is examined in terms of its socio-economic impacts, the legal aspects of policy and patents, and the Third World concept of a transnational regime. The analysis continues with a discussion of

the factors affecting international conflict and a set of criteria for resolving competing claims. It concludes with suggested reforms which would take account of the Third World concerns by restructuring the institutions of health and social planning on the basis of meeting real needs. 467 notes and references. (DCK)

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 28213, 28214, 28269, 28304, 28681, 28731, 28762, 28787, 28818, 29366

28774 (DOE/NE/44143—T1) Managing the nation's high-level radioactive waste: key issues and recommendations. (Conservation Foundation, Washington, DC (USA)). Jul 1981. Contract AC01-81NE44143. 55p. NTIS, PC A04/MF A01. Order Number DE81027550.

To date, no unified national plan has been adopted to develop and implement a comprehensive system of management and disposal of high-level radioactive waste in the United States. Growing public concern about this problem has resulted in a number of recent efforts to develop a national high-level waste management policy. The 96th Congress strove to resolve the central issues, but ultimately failed to pass legislation, partly because of disagreements about the appropriate role of states in the siting of repositories for military waste. Outside government, a number of organizations convened representatives of diverse groups concerned with national high-level radioactive waste management to seek agreement on the major elements of national policy. One such organization was RESOLVE, Center for Environmental Conflict Resolution, which in May 1981 was merged into The Conservation Foundation. RESOLVE convened Forum II, a series of discussions among representatives of environmental, industrial, governmental, and citizen interest groups, in 1981 specifically to address the issues blocking Congressional agreement on high-level waste policy. This report contains the recommendations which resulted from these deliberations. Reprocessing, interim storage, respository development, and licensing requirements are addressed. Federal, state, and public participation in decision making are also discussed.

28775 (PNL—3797) Public concerns and choices regarding nuclear-waste repositories. Rankin, W.L.; Nealey, S.M. (Battelle Pacific Northwest Labs., Richland, WA (USA); Battelle Human Affairs Research Center, Seattle, WA (USA)). Jun 1981. Contract AC06-76RL01830. 43p. (BHARC—411/81/003). NTIS, PC A03/MF A01. Order Number DE81027835.

Survey research on nuclear power issues conducted in the late 1970's has determined that nuclear waste management is now considered to be one of the most important nuclear power issues both by the US public and by key leadership groups. The purpose of this research was to determine the importance placed on specific issues associated with high-level waste disposal. In addition, policy option choices were asked regarding the siting of both low-level and high-level nuclear waste repositories. A purposive sampling strategy was used to select six groups of respondents. Averaged across the six respondent groups, the leakage of liquid wastes from storage tanks was seen as the most important high-level waste issue. There was also general agreement that the issue regarding water entering the final repository and carrying radioactive wastes away was second in importance. Overall, the third most important issue was the corrosion of the metal containers used in the high-level waste repository. There was general agreement among groups that the fourth most important issue was reducing safety to cut costs. The fifth most important issue was radioactive waste transportation accidents. Overall, the issues ranked sixth and seventh were, respectively, workers' safety and earthquakes damaging the repository and releasing radioactivity. The eighth most important issue, overall, was regarding explosions in the repository from too much radioactivity, which is something that is not possible. There was general agreement across all six respondent groups that the two least important issues involved people accidentally digging into the site and the issue that the repository might cost too much and would therefore raise electricity bills. These data indicate that the concerns of nuclear waste technologists and other public groups do not always overlap.

28776 Reducing uranium resource uncertainty: is it worth the cost. Gilbert, R.J. (Univ. of California, Berkeley); Richels, R.G. *Resources and Energy ;* **3**: No. 1, 13-37(Mar 1981).

This paper provides a conceptual framework for estimating the value of information to energy-policy decisions and applies the methodology to assess the expected economic value of the US Department of Energy's National Uranium Resource Evaluation (NURE) program. Uranium-resource information is modeled by a likelihood function imbedded in a decision tree describing possible nuclear-power-development strategies. Results of the study show that the value of uranium-resource information is potentially large compared to the cost of the NURE program. Attaining the large potential benefits will be difficult, however, since the information must be extraordinarily accurate to have a significant impact on the choice of nuclear-policy options. 12 references, 2 figures, 12 tables.

28777 Nonproliferation and US foreign policy. Yager, J.A. (ed.). Washington, DC; The Brookings Institution (1980). 442p.

This book, of six parts, examines the present and possible future incentives for and against the acquisition of nuclear weapons by a number of countries. The authors find that the countries studied differ greatly in their approach to nuclear issues and in their susceptibility to US influence. These differences and the fact that other foreign-policy goals often take precedence make it almost impossible for the United States alone to carry out a consistent and effective nonproliferation policy. The best hope seems to lie in the creation of new international arrangements for civil nuclear energy and in the promotion of a more-secure international environment in which countries that now feel threatened will have less reason to obtain nuclear weapons. The authors have chosen for analysis countries that are capable of building nuclear weapons within a relatively short time and that may have some incentives for doing so. Joseph A. Yager discusses Japan, South Korea, and Taiwan; Richard K. Betts, India, Pakistan, Iran, and South Africa; Henry S. Rowen and Richard Brody, the Middle Eastern Arab states and Israel; and William H. Courtney, Argentina and Brazil. Introductory and concluding chapters are provided by the editor.

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 28816, 28902, 28909, 28910, 28917, 28918

2910 Conservation

REFER ALSO TO CITATION(S) 28757, 28871, 28874, 28882, 28885, 28887, 28889, 28890, 28900, 28911, 28912, 28916

28778 (DOE/CS—0208) Conservation and solar energy program: congressional budget request, FY 1982. (Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy). Jan 1981. 337p. NTIS, PC A15/MF A01. Order Number DE81014543.

Funding summaries are presented for the Conservation and Solar Energy Program funding information and program overview on energy conservation (Volume 7 of 7, DOE/CR-0011/2) are included for the Buildings and Community Systems, Industrial, Transportation; State and Local, Multi-Sector, Energy Impact Assistance, and Residential/Commercial retrofit programs. Funding information and program overviews on solar technology (Volume 2 of 7, DOE/CR-011/2) are included for Active and Passive Solar Heating and Cooling, Photovoltaics Energy Systems, Solar Thermal Power Systems, Biomass Energy Systems, Wind Energy Conversion Systems, Ocean Systems, Solar International Activities, Solar Information Systems, SERI Facility, MX-RES, Program Direction, and Alcohol Fuels programs. Information and overviews on energy production, demonstration, and distribution (Volume 6 of 7, DOE/CR-0011/2) are given for the solar program. A funding summary and a program overview are included for electrochemical and physical and chemical storage systems as appearing in DOE/CR-0011/2, Volume 3 of 7. Relevant tabulated data from the FY 1981. Request to the Congress are presented for Supplementals, Rescissions, and Deferrals. (MCW)

28779 **(DOE/CS/40004—T9) Analysis of the National Energy Plan.** (TRW Systems Group, McLean, VA (USA)). 17 Jun 1977. Contract AC03-77CS40004. 46p. NTIS, PC A03/MF A01.

The plan is treated by end-use sectors, except for utilities and fuel prices which are presented as separate topics. First, the specific strategies and policies contained in the April 20, 1977, White House Fact Sheet and the April 29, 1977, publication entitled, The National Energy Plan (NEP) are itemized. Next, a further explanation of several of the policies is provided based on information in HR 8631, The National Energy Act. Finally, an analysis of some of the implications of the NEP is performed. The analysis is oriented to aspects of the NEP that are pertinent to ERDA's conservation programs. After an overview, the topics are treated in the following order: industry; utilities; residences; buildings; transportation; and energy prices and availability.

28780 **(EMD—81-55) Status and funding of the Department of Defense Energy Conservation Investment Program.** (General Accounting Office, Washington, DC (USA)). Feb 1981. 33p. General Accounting Office, Washington, DC. Order Number DE81903697.

The status and funding of the Department of Defense Energy Conservation Investment Program for 1979 and 1980 are summarized. Schedules of variances between appropriated amounts and current working estimates are given for fiscal years 1979 and 1980. (LEW)

28781 **Worker/vehicle ratios at major eastern power plant construction sites: a time of change.** Metz, W.C. (Brookhaven National Lab., Upton, NY). *Traffic Quarterly ;* **35**: No. 3, 433-443(Jul 1981).

A 1979 survey of the worker/vehicle ratios at 16 powerplant construction sites averaged 2.3. A trend toward higher ratios in recent years indicates that costs are overcoming single-occupant commuting habits. Five factors influencing how workers commute to the site are parking area and site accessibility, residence location, workforce composition and scheduling, gasoline availability and price, and van or bus availability. A sixth factor, project management involvement to encourage ridesharing, may increase as data for commuting research and monitoring becomes available. Management participation can include the dissemination of information to workers and special parking and lane incentives, but will avoid the liabilities associated with fiscal participation. Government assistance can include research data, public bus routing, and parking lot development. 21 references, 1 table. (DCK)

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 28152, 28760, 28790, 28792, 28793, 28797, 28802, 28813, 28901, 29144

28782 **(DOE/PE—0029) Energy projections to the year 2000.** (USDOE Office of Policy, Planning and Analysis, Washington, DC). Jul 1981. 158p. NTIS, PC A08/MF A01. Order Number DE81027525.

Energy projections prepared in conjunction with the National Energy Policy Plan (NEPP) are presented. The projections were developed within the US Department of Energy by the Division of Analytical Services, under the Director of Policy, Planning, and Analysis. Underlying these projections are certain assumptions about key input variables - world oil prices, economic growth, and domestic energy production potential - which are also described in this document. The assumptions are based on information available to the Division of Analytical Services through June 1981. Projecting US energy supply and demand through the year 2000 in today's energy environment is by nature a highly uncertain process. These projections try to account for uncertainty by providing ranges for all estimates, based on alternative assumptions about key uncertainties affecting the energy market. Projections should not be viewed as a statement of goals or targets. They represent an analysis of the expected evolution of US energy markets through 2000, given current information and existing policies. As circumstances change in the future, projections will change as well--so that these will be updated accordingly.

28783 **Proceedings international workshop on energy survey methodologies of developing countries.** Washington, DC; National Academy Press (1980). 226p. (CONF-800163—).

From International workshop on energy survey methodologies for developing countries; Jekyll Island, GA, USA (21 Jan 1980).

The major aim of the workshop was to provide a forum for sharing knowledge and experience about ways to improve information for energy planning and policy making. During the workshop, 4 working groups discussed past experience with and special needs of energy surveys in rural areas, urban areas, and the transportation and industrial sectors of national economies. The reports of these working groups are included in these proceedings. A bibliography with abstracts of past and current work in the energy survey field is also included. The appendix contains exerpts from 12 background papers prepared for the workshop.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 28156, 28170, 28740, 28762, 28765, 28774, 28802, 28871, 29255, 29256

28784 **(DOE/RG—0045/1Rev.6-81) Compliance problems of small utility systems with the Powerplant and Industrial Fuel Use Act of 1978: Volume 1.** (Department of Energy, Washington, DC (USA). Economic Regulatory Administration). Jun 1981. 106p. NTIS, PC A05/MF A01. Order Number DE81027187.

The Powerplant and Industrial Fuel Use Act of 1978 (FUA) prohibits the use of petroleum and natural gas in new powerplants, and prohibits the construction of new powerplants without the capability of using an alternate fuel as a primary energy source. The Act also restricts the pre-1990 natural gas use of existing powerplants which used gas in 1977 to retain historical base period proportions, and prohibits the pre-1990 use of natural gas in electric powerplants which did not burn gas in 1977 and the post-1990 use of natural gas in any electric powerplant. Section 744 of the FUA (P.L. 95-620) instructs the Secretary of Energy to conduct a study of the problems of compliance with this Act experienced by those electric utility systems which have a total system generating capacity of less than 2000 megawatts. The general objectives of this study, based on the prohibitions and restrictions of using natural gas as a primary boiler fuel and the population of utilities generating less than 2000 MW, are: (1) inventory small utility systems subject to the Act and determine their fuel use and distributions; (2) identify the small utilities' own perceptions of their compliance problems with the Act; (3) evaluate the validity of small utilities' perceptions of these problems; and (4) identify and evaluate options for alleviating small utility compliance problems, consistent with the intent and purpose of the Act. Results are presented in detail. (WHK)

28785 **(DOE/RG—0045Vol.1) Compliance problems of small utility systems with the Powerplant and Industrial Fuel Use Act of 1978: Volume 1.** (Department of Energy, Washington, DC (USA). Economic Regulatory Administration). Jun 1981. 106p. NTIS, PC A06/MF A01. Order Number DE81012022.

The Powerplant and Industrial Fuel Use Act of 1978 (FUA) prohibits the use of petroleum and natural gas in new powerplants, and prohibits the construction of new powerplants without the capability of using an alternate fuel as a primary energy source. The Act also restricts the pre-1990 natural gas use of existing powerplants which used gas in 1977 to retain historical base period proportions, and prohibits the pre-1990 use of natural gas in electric powerplants which did not burn gas in 1977 and the post-1990 use of natural gas in any electric powerplant. Section 744 of the FUA (P.L. 95-620) instructs the Secretary of Energy to conduct a study of the problems of compliance with this Act experienced by those electric utility systems which have a total system generating capacity of less than 2000 megawatts. The general objectives of this study, based on the prohibitions and restrictions of using natural gas as a primary boiler fuel and the population of utilities generating less than 2000 MW, are: (1) inventory small utility systems subject to the Act and determine their fuel use and distributions; (2) identify the small utilities' own perceptions of their compliance problems

with the Act; (3) evaluate the validity of small utilities' perceptions of these problems; and (4) identify and evaluate options for alleviating small utility compliance problems, consistent with the intent and purpose of the Act. Results are presented in detail. (WHK)

28786 **(DOE/RG—0045Vol.2) Compliance problems of small utility systems with the Powerplant and Industrial Fuel Use Act of 1978: volume II - appendices.** (Department of Energy, Washington, DC (USA). Economic Regulatory Administration). 1981. 381p. NTIS, PC A17/MF A01. Order Number DE81011910.

A study of the problems of compliance with the Powerplant and Industrial Fuel Use Act of 1978 experienced by electric utility systems which have a total generating capacity of less than 2000 MW is presented. This volume presents the following appendices: (A) case studies (Farmington, New Mexico; Lamar, Colorado; Dover, Delaware; Wolverine Electric Cooperative, Michigan; Central Telephone and Utilities, Kansas; Sierra Pacific Power Company, Nevada; Vero Beach, Florida; Lubbock, Texas; Western Farmers Cooperative, Oklahoma; and West Texas Utilities Company, Texas); (B) contacts and responses to study; (C) joint action legislation chart; (D) Texas Municipal Power Agency case study; (E) existing generating units jointly owned with small utilities; (F) future generating units jointly owned with small utilities; (G) Federal Register Notice of April 17, 1980, and letter of inquiry to utilities; (H) small utility responses; and (I) Section 744, PIFUA. (WHK)

28787 **(DOE/S—0008) Securing America's energy future: the national energy policy plan.** (Department of Energy, Washington, DC (USA)). Jul 1981. 37p. NTIS, PC A03/MF A01. Order Number DE81026612.

During its first six months, the Administration has reformulated energy policy guidelines within the context of its overall Economic Recovery Program. This new national energy policy (of which Executive Branch action is but one part) will continue to develop and to be refined; it will not be tied to a static and unresponsive plan. This document defines the approach for reformulation of policy, and it presents the current energy outlook of the Nation. It is submitted to Congress in accordance with the requirements of Section 801 of the Department of Energy Organization Act (Public Law 95-91). As specific new legislative policy initiatives are developed over the coming months, they will be forwarded promptly to Congress.

28788 **(P—140-81-001) Need for Pacific Gas and Electric Company and Southern California Edison's participation in the Harry Allen-Warner Valley Energy System. Staff report.** Grueneich, D.; Marcus, D. (California Energy Resources Conservation and Development Commission, Sacramento (USA)). Mar 1981. 201p. California Energy Resources Conservation and Development Commission, Sacramento. Order Number DE81903669.

In late 1979, Pacific Gas and Electric Company and Southern California Edison filed an Application with the California Public Utilities Commission (CPUC) for a Certificate of Public Convenience and Necessity for the Harry Allen-Warner Valley Energy System. From the beginning, need for the project was a major issue in the proceeding. In March 1980, the California Energy Commission intervened in the CPUC proceeding. The CPUC ruled that the CEC's adopted forecast would be used in determining need and the parties addressed not only the CEC's forecast but many other CEC materials, including the Biennial Report, during the proceeding. The following brief was prepared at the end of the hearings, presenting the CEC staff's proposed position on need. However, prior to a final CEC decision on whether to adopt this brief, the utilities withdrew their CPUC Application in order to reevaluate the need for the project. Even though the CEC never formally adopted the brief, the brief is being made available as a staff document, so that the public may benefit from the extensive record compiled on the issue of need and the availability of alternatives.

28789 **(P—500-81-006) State Agricultural and Forestry Residue Utilization Act of 1979.** (California Energy Resources Conservation and Development Commission, Sacramento (USA)). Jan 1981. 38p. California Energy Commission, Sacramento. Order Number DE81903671.

This is the first annual report on the status of the Commission's Biomass Demonstration Program established by the State Agricultural and Forestry Residue Utilization Act (SAFRUA) of 1979 (Chapter 1123, Statutes of 1979). This report does not contain policies or recommendations for policies but is intended as a first year status report to inform all interested parties on the progress of the program.

28790 **1981 Guide to Federal energy development and assistance programs.** Feathers, J. (ed.). Washington, DC; Northeast-Midwest Institute (1981). 269p. $5.00.

This guide catalogs more than 70 government programs and agencies offering grants, loans, loan guarantees, technical assistance, and other forms of aid and funding to state and local governments, community organizations, businesses, and individual homeowners, tenants, and entrepreneurs. Each entry lists basic information on the program's objective, its fiscal year 1981 appropriation, the form and average levels of financial assistance, the funding cycle, and eligibility criteria. It also provides examples of how the program has been used in the past. Extensive information is included on available tax credits and supplementary sections on urban, rural, and community energy strategies, and conservation. Also provided are listings of government and non-government information sources, a directory of national and regional Federal offices, a glossary of energy terms, and four comprehensive indexes. Recent changes in the first concurrent budget resolution for fiscal 1982 have had a significant impact on the programs listed in this guide. To keep users abreast of these changes, each guide comes with an update explaining the changing status and funding levels of all programs mentioned.

28791 **Fiscal year 1982 budget review. Hearings before the Committee on Environment and Public Works, United States Senate, Ninety-Seventh Congress, first session February 25, 26, March 4, 5, and 6, 1981.** Washington, DC; Government Printing Office (1981). 878p.

Testimony is presented from: Federal Highway Administration; Nuclear Regulatory Commission; Corps of Engineers, Water Resources Council, and the Office of Water Research and Technology; Environmental Protection Agency; Fish and Wildlife Service; and Economic Development Administration, Appalachian Regional Commission, Title V Commissions, and Federal Emergency Management Agency. (PSB)

28792 **National energy profiles.** Stunkel, K.R. (ed.). New York, NY; Praeger Publishers (1981). 425p.

This volume is concerned with the role, fitness, and prospect of nations as managers and policymakers in the domain of world energy sources. Eight countries are considered, falling roughly into two groups: (1) developed - the United States, the Soviet Union, and Japan; and (2) developing - China, Brazil, Mexico, Nigeria, and Taiwan. The editor notes that: The spirit of this book is frankly normative and policy oriented; and the empirical analysis of the usual social science studies is mingled with a deliberate consideration of useful and meaningful goals, with self-conscious acceptance of the premise that certain preferred values ought to govern any rational, sensible energy policy. A separate abstract was prepared for each of the nine chapters.

28793 **Introduction: energy and the future of nations.** Stunkel, K.R. (Monmouth Coll., West Long Branch, NJ). pp 1-36 of National energy profiles. Stunkel, K.R. (ed.). New York, NY; Praeger Publishers (1981).

An historical and global view of energy can be gained by examining its causal relationships to the concepts of nationalism and a growing world population, thermodynamic entropy, biological evolution, and spaceship earth. Man has only recently begun to recognize the patterns and consequences of global energy requirements and use as self-sufficiency gives way to social interdependence. Resource depletion threatens a short life for an industrialized society, which consumes faster than it can provide substitutes and whose institutions have failed two-thirds of the world's population. A rational energy policy would strike a balance between overly optimistic and doomsday visions by recognizing and assigning a true value to resources and the limitations and costs of technological solutions. The wide disparity between global economic progress and the magnitude of global poverty as well as the growing awareness among

the poor of this disparity underscores the need for appropriate energy development to meet basic needs. A social order based on equity and environmental responsibility is basic to a world energy policy capable of addressing these problems. The eight chapters of this book examine the national profiles of the US, Soviet Union, Japan, People's Republic of China, Brazil, Mexico, Nigeria, and Taiwan. 79 references. (DCK)

28794 **United States.** Rosen, D.J. (Rutgers Univ., New Brunswick, NJ). pp 39-81 of National energy profiles. Stunkel, K.R. (ed.). New York, NY; Praeger Publishers (1981).

The energy component of US development and a consuming life style during a period of secure and inexpensive energy supplies has made the US the highest per capita consumer in the world, straining both the environment and international relationships. The energy mix has changed with technological innovation along with the rate of consumption, a shift to centralized energy generation, and shifts from energy use for basic home needs to the production and marketing of goods and the transportation of both goods and people. The American people perceived in the early 1970's that this growth was not improving the quality of life, and they began demanding domestic energy policies to deal with the impacts of energy use. The government's response is traced in the development of energy sources and found to be lacking in either planning or boldness, especially in the need to reduce US dependence on Middle East oil. A review of the effort to develop a comprehensive National Energy Plan reveals the government's inability to cope with problems of nuclear safety, coal production, energy conservation, and a balance between energy supply and environmental quality. The US is now more aware of the international implications of energy policy and the need for cooperative planning. Future policy decisions must choose between the hard and soft paths and accept the risks involved with each. 67 references, 3 tables. (DCK)

28795 **Soviet Union.** Kelley, D.R. (Univ. of Arkansas, Fayetteville). pp 82-119 of National energy profiles. Stunkel, K.R. (ed.). New York, NY; Praeger Publishers (1981).

Policies focused on rapid industrial growth, especially heavy and defense industries, and a shift from indigenous coal and lignite to oil and nuclear power characterize energy use in the Soviet Union. A breakdown of actual consumption patterns illustrates the poorly developed state of consumer production. Soviet policy has always keyed industrial growth to a strong domestic economy, but planners are becoming increasingly concerned that social and economic problems will slow continued growth. An increasing dependence on high technology from the West, lagging research, and manpower problems are already slowing the GNP growth rate. Projections for domestic energy development may be overly optimistic and may require lower expectations for development. Energy production and conservation opportunities are outlined even though accurate information is difficult to obtain. Energy exports give the USSR some short-run economic and political advantages. Environmental issues have been raised in the past decade, but the emphasis of the centralized government continues to give development top priority. Unlike other industrial nations, unlimited growth prospects continue to be an article of faith for Soviet leaders. Domestic energy shortfalls will probably be delayed and less severe, but the lack of a centralized environmental program may cause trouble in the short term. 47 references. (DCK)

28796 **Japan.** Stunkel, K.R. (Monmouth Coll., West Long Branch, NJ). pp 120-170 of National energy profiles. Stunkel, K.R. (ed.). New York, NY; Praeger Publishers (1981).

Ranking second in market and third in the world economy, Japan's energy use has been growing for 90 years. Imported oil dominates current consumption in a country that produces only 10% of its primary energy. Dependence on oil will continue longer than for other industrialized countries, but the use of domestic coal and hydropower will begin to increase. The intensity of post-war development make Japanese industry a leading contender for the most energy-intensive and pollution-prone. The physical and social systems are already overtaxed, but the problems and the need to shift to high technology are recognized. More growth in energy use is projected for the near future because the economy is geared to rapid growth and government planners appear to be indecisive. The high cost of oil has not affected consumption policies or promoted more than superficial conservation efforts other than some recycling projects which lack a national focus. Some interest in energy self-sufficiency is developing, but national policy is investing in more oil. Nuclear development policies are uncertain, as are fusion, solar, and geothermal energy. Japan's oil industry emphasizes refining crude oil from Mid-East suppliers and marketing petroleum products. China may become a new supplier of natural gas in return for liquefaction technology. All of Japan's suppliers involve complex international relations and competition. 111 references, 5 tables. (DCK)

28797 **People's Republic of China.** Kim, S.S. (Princeton Univ., NJ). pp 171-218 of National energy profiles. Stunkel, K.R. (ed.). New York, NY; Praeger Publishers (1981).

Chinese energy and economic policies reflect national values and the allocation of resources in a country that has only 7% of the world's arable land to feed 20% of its people. Energy development in China reflects its path toward modernization and provides a framework for other developing countries to study. Subsistence agriculture based on animal and human muscle power sustained the Chinese economy for millenia until foreign imperialism and later the establishment of the People's Republic of China (PRC) brought changes to energy development. While rural China continues in a solar-dominated ecosystem, commercial and industrial activities rely increasingly on coal, oil, natural gas, and hydroelectric power. Energy policy has been unpredictable, changing frequently because of political and environmental pressures, and resulting in economic development that is both uneven and impressive. Policy changes in the post-Mao era emphasize modernization and a shift in priority from political to economic considerations. A review of world energy and economic impacts and Chinese responses covers domestic energy development and international policy as the PRC transferred itself from a dependent consumer to a self-sufficient exporter. A systems approach to environmental protection has so far avoided many of the pollution problems and may continue to do so despite policies that recognize the supply-and-demand linkage of energy and modernization. 119 references, 3 tables. (DCK)

28798 **Brazil.** Erickson, K.P. (City Univ. of New York, NY). pp 219-269 of National energy profiles. Stunkel, K.R. (ed.). New York, NY; Praeger Publishers (1981).

The oil crisis of the 1970's created special problems for Brazil, which was emerging from a Third World status into a period of optimistic development. Brazil's growth policies, however, were based on imported oil. To continue this development, the country must sustain a high growth rate at the same time it becomes more energy-efficient. Energy-use changes from wood to oil took only one generation, with wood, oil, and hydropower now supplying 85% of the nation's energy. A review of energy policies suggests that the adoption of the US as a model was unfortunate because most of the development surge has been in energy-intensive sectors. An unusual decline in the ratio of energy consumption to gross national product is likely a one-time rise in apparent efficiency that can accompany the shift to modern equipment. Brazil must increase domestic energy development, increase nonenergy exports, or decrease energy consumption in order to continue its economic development. The policies and practices that Brazil's planners must design and implement to pursue these goals are discussed, but no way is seen to make the country self-sufficient in energy production in the foreseeable future. A bid for world power status will rest on the success of Brazil's energy policies. The environmental impacts associated with extensive energy development are intensified by a lack of responsible effort even though the technology to minimize pollution is available. The country suffers from a small environmental movement and a loose energy policy. 127 references, 3 tables. (DCK)

28799 **Mexico.** Randall, L.R.R. (City Univ. of New York, NY). pp 270-314 of National energy profiles. Stunkel, K.R. (ed.). New York, NY; Praeger Publishers (1981).

Limited water power and poor-quality coal have made Mexico increasingly dependent on petroleum, nuclear, and nontraditional energy sources in the 20th century. Private development of energy production declined in the 1930's as government control, notably through Pemex, took over. Government control has affect-

ed the use as well as the supply of energy in Mexico's effort to achieve economic development based on energy exports. Mexicans are convinced that the US will request more of its oil than they wish to sell, which underscores the importance of correlating energy development with economic and foreign policy. The country has not developed strong, effective environmental or energy-saving regulations. Giant oil discoveries are the basis for Mexico's faith in the future, with oil development a cornerstone of development plans. A review of Mexico's energy and economic plans covers all energy sources and their assigned priority. As a net exporter, Mexico is neither a member of OPEC nor willing to form bilateral producer agreements, although it is interested in foreign investment and the transfer of technology. 130 references, 4 tables. (DCK)

28800 **Nigeria.** Wilson, E.J. III. (Resources for the Future, Washington, DC). pp 315-358 of National energy profiles. Stunkel, K.R. (ed.). New York, NY; Praeger Publishers (1981).

Nigeria is an industrializing country which is also the world's seventh largest oil exporter and eager to use oil prices to finance its own development. Since the demand for domestic energy is greatest at the beginning of economic development, Nigeria has also been importing petroleum products. A large noncommercial sector relying on wood and animal wastes and a decentralized political system which is converting from military to civilian rule, Nigeria offers a unique profile. As the country emerges from the effects of colonial rule and shifts its energy policy from one of production to that of distributing goods and services, politics continues to be an important factor. The 1980's will be a period for building an infrastructure to promote balanced energy production and economic growth. A review of Nigeria's energy supplies and development plans in this context concludes that regional and ethnic disparities will continue to affect international as well as domestic policies until they are reconciled. Environmental considerations have not yet emerged as political issues, although pollution problems exist. Nigeria's future will depend on its success in developing an infrastructure able to implement its policies. 82 references, 11 tables. (DCK)

28801 **Taiwan.** Copper, J.F. (Southwestern Univ., Memphis, TN). pp 359-388 of National energy profiles. Stunkel, K.R. (ed.). New York, NY; Praeger Publishers (1981).

Taiwan's fast-growing economy requires a heavy dependence on energy imports, even though the island was once considered ideal for energy self-sufficiency. Coal, petroleum, and natural gas were adequate until the 1950's, when rapid development exceeded energy capacity because of an energy-intensive industrial expansion, a rising per capita income, and a rapid growth in population. Domestic energy policies seeking to develop all fossil and renewable energy sources have not kept up, however, causing new international strains in the world market. Nuclear development was undertaken in the late 1960's as a low-cost alternative to Middle East oil and to mitigate serious pollution problems. Rapid urbanization has progressed faster than environmental policies, and development policies will likely continue to subordinate environmental issues unless the pollution interferes with international regulations. Future development may ultimately depend on Taiwan's finding cheaper and cleaner energy sources and using them more efficiently. 110 references. (DCK)

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 28054, 28097, 28106, 28106, 28152, 28153, 28156, 28163, 28169, 28170, 28173, 28584, 28584, 28585, 28585, 28762, 28818, 29255, 29256, 29257

28802 **(P—300-81-004) Oil allocation supply test.** (California Energy Resources Conservation and Development Commission, Sacramento (USA)). [nd]. 250p. California Energy Commission, Sacramento. Order Number DE81903666.

The IEA tested its ability to redistribute limited oil supplies among member-nations, while the US Department of Energy and eight representative states tested the national oil emergency response. This report describes the CEC's participation in the IEA test and notes several deficiencies in existing state and national emergency plans. These deficiencies specifically include the overestimated capacities of state and federal emegency conservation plans, the lack of importance assigned to the emergency allocation of domestic oil supplies, the unavailability of critical information necessary to operate state emergency plans, and the failure to consider the political and economic aspects of an oil shortage. The report also concludes that West Coast oil supplies will be diverted to offset shortage impacts in other states and IEA member-nations, and that without the IEA exercise, weaknesses in existing emergency plans would have gone unnoticed until an actual emergency. To shore up state and national emergency plans, the report recommends that the national government review existing federal emergency laws for workability, establish a real-time international information and communication network, expand the existing national communication network, and sanction a common set of terms and definitions to eliminate confusion during oil emergencies. States should develop the capability to verify federal emergency actions, determine the types of information necessary at the beginning of a shortage, and become familiar with the mechanics of the IEA oil-sharing system. The report also recommends that PADD V states share data and coordinate their emergency planning actions. The report suggests that future tests be expanded to include price considerations and the economic effects of oil shortages, and that the testing process be used to train emergency response teams at state and local levels.

28803 (CONF-810498—(Vol.1), pp 1-10) **Coal oil mixture (COM) in the Australian context.** Nicol, S.K.; Brock, C.W.; Millin, L.J.; Smitham, J.B. (Broken Hill Proprietary Co. Ltd., Australia). 1981. NTIS, PC A20/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

Coal has traditionally been the fuel used to generate electricity in Australia. This circumstance, combined with Australia's own oil supplies, has cushioned energy users from the rapid rise in oil prices that has occurred since the early 1970's. However, substantial quantities of oil are still fired in industrial furnaces and in some marine applications. The Australian Steel Industry has been concerned about these remaining applications of oil combustion and instigated a research and development program to reduce oil usage by substituting coal for oil. As a result of the Broken Hill Proprietary Company's successful conversion of its Open Hearth furnaces from oil to COM, a process has been developed for producing COM based on the use of the selective agglomeration of fine coal by the addition of oil to an aqueous coal slurry. In this way, not only is the ash level in the coal reduced by the selective agglomeration process, but the COM can be made up on demand from easily stored agglomerates thus avoiding the problem of long term COM stability. Details of this approach and the advantages and implications will be discussed.

28804 (CONF-810498—(Vol.1), pp 11-25) **Overview of the Canadian COM program.** Whaley, H. 1981. NTIS, PC A20/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

The effect of the increasing differential between the cost of fuel oil and coal in Canada had led to the initiation of a program encompassing the technologies relating to the combustion of mixtures of coal and oil (COM). COM technology provides a short to medium term energy source which has significant potential in reducing oil consumption at power stations, industrial steam raising and other process equipment that was originally designed for oil-firing and cannot readily be converted to alternate fuels. Energy, Mines and Resources Canada is supporting the utilization of COM technology through the COM program, economic factors will dictate whether or not the technology is implemented. The Canadian COM program embraces both demonstration-scale projects and associated research and development. The demonstration projects have included the COM firing of a 10 MW(e) utility boiler at Chatham, New Brunswick with plans for the firing of a larger unit. Also in the demonstration program are the first phases of a commercial COM preparation facility and a blast furnace tuyere COM injection project. Research and development studies include COM preparation, properties and combustion. An important part of the program has been the application of the spherical agglomeration process to

the benefication of high-ash eastern Canadian coals and its integration into COM preparation. The feed coal for the utility demonstration project has been reduced to less than 10% ash and 4 to 5% sulfur from 20 to 25% ash and 7 to 8% total sulfur using the process.

28805 (CONF-810498—(Vol.1), pp 26-46) **Research work on coal-oil mixture combustion in China.** Hao, L. (Tsinghua Univ., Beijing, China). 1981. NTIS, PC A20/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

China is a developing country. The use of coal-oil mixture (COM) as an energy fuel presently is a suitable method for rational utilization of fuel and change of the energy structure. Due to the difference in coal and oil properties, the fundamental and rheologic properties of Chinese coal-oil mixture have been studied. As some Chinese heavy oils have a rather high content of wax, the sedimentation of the pulverized coal and the viscosity of Chinese COM are much influenced by its temperature; therefore, low-temperature storage and high-temperature transportation are used in the COM system. Theoretically, COM is a dilatant fluid. When its pulverized coal content is below a certain limit, it may be considered as a Newtonian fluid. During its transportation in engineering practice, its flow region is within that of a laminar flow. At present, all the COM in China is manufactured by mechanical agitating of pulverized coal and residual oil. The use of hydraulic dynamical and electrical supersonic method for the emulsion of COM have already been carried out on bench scale. The making of COM by wet will be studied later. The work to provide some cheap and abundant additives has been started and will be continued. In its transportation, rotating gear pump and reciprocating pump for tar are used. Both utilize a variable-speed motor driving with low speed in order to reduce wear and for load adjustment. Different types of atomizers and registers for COM have been tested in laboratories and small boilers. Steam-assist twin fluid with mixing chamber atomizer and parallel-flow register give better result. In burning COM with different concentrations of coal by weight in a 15 t/hr oil-fired boiler showed there is a very little change in boiler efficiency with no decrease in boiler rating. The economical considerations for using COM in China have been studied and will be carried out to get a layout of the COM supply system and economical retrofit of boilers.

28806 (CONF-810498—(Vol.1), pp 47-55) **Outline of the French DGRST's coal-oil mixture R & D program.** Ladurelli, A.J. 1981. NTIS, PC A20/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

With the current emphasis on increasing the French industrial consumption of coal, the coal-oil mixture (COM) is regarded as a near-term technology permitting the partial conversion to coal of the existing industrial oil-fired boilers and furnaces. In June 1980, the so-called Delegation Generale a la Recherche Scientifique et Technique (DGRST), one of the government agencies responsible for the promotion and public financing of certain industrial and university research programs, granted the first French COM program. This program is jointly carried out by a group of French companies and organisations. The general adjective is to study and compare various COM production conditions and the corresponding combustion, storage and handling characteristics. The paper shows the main features of the experimental program which is under way: Laboratory study of stability, rheology and combustion parameters. Particular emphasis is placed on selection of additives. Production and storage tests in pilot units. Two types of COM production are tested (batch mixing and in-line mixing). Circulation loop tests on the reliability, fouling and abrasion of pumps, valves, flow meters and pressure regulating equipment. Firing tests with a 1 MW experimental furnace. This program is expected to be completed at the end of 1981.

28807 (CONF-810498—(Vol.1), pp 56-62) **Utilization of coal-oil in Italy: research, development, and achievements.** Monti, F.; De Michele, G. 1981. NTIS, PC A20/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

The role of coal in the Italian energy program in the short and medium term is growing. In the first five years of eighties, in the area of electricity generation the major potential area of coal consumption, the Italian program provides for an increase of coal consumption by recourse to coal firing in power stations that were designed also for this possibility, in addition to stations that already burn coal. A second stage is provided for the commissioning of new coal fired stations and when plants will start operation coal consumption will grow further on. Other and more complex programs are going to start in the field of industrial applications. The possibility to use coal in industrial and utility boilers that were projected to use only gas or oil to increase further on its consumption by COM utilization could be taken into consideration in both programs. In this frame two Italian firms, AgipPetroli and ENEL, that are following their own research and development programs in COM preparation and utilization, decided, in addition to this, to join their efforts and defined a joint research program. This program includes the construction of a COM preparation system able to prepare COMs of different quality to feed an industrial oil fired boiler and some burners of a large power stations. The aim of research project is to obtain information about COM preparation system features and boilers and burners retrofitting. In the work are described the steps and the details of AgipPetroli/ENEL project.

28808 (CONF-810498—(Vol.1), pp 63-72) **Overview of R & D activities on COM in Japan.** Nakabayashi, Y. (Electric Power Development Co., Ltd., Tokyo, Japan). 1981. NTIS, PC A20/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

The chief activities of COM research and development in Japan since the second symposium at the end of 1979 are explained. (1) The demonstration test project is described for the conversion to COM combustion of existing oil fired designed boilers by the Electric Power Development Co., Ltd. (EPDC). (2) Blast furnace tests are being performed by Sumitomo Metal Industries Co., Ltd. (SMI) and other steel firms in Japan. (3) The first large scale commercial COM project is being carried out by Tokyo Electric Power Co., Ltd. (TEPCO). (4) The current situation in research and development of advanced COM technology in Japan is described.

28809 (CONF-810498—(Vol.1), pp 73-84) **Overview of the current status of the Swedish coal-oil-water mixture program.** Larsson, E. 1981. NTIS, PC A20/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

The National Swedish Board for Energy Source Development (NE) has sponsored several projects on COM. (1) Sedico Energi AB and Ugnsbolaget TABO have developed a coal-oil mixture (MURF) consisting of pulverized coal wetted with 6% oil as a transportation form. In front of the MURF combuster, which can be described as a cyclone furnace, 20% water is added to make a slurry ready for combustion. (2) Ab Carbogel has developed mixture of pulverized cleaned coal with water and additive. With 30% water there is a tixotropic pumpable fuel. A new burner has also been constructed. The fuel and the burner will be tested in a small district heating boiler during the spring 1981. The comprehensive test program includes extensive emission measurements as well as boiler efficiency calculation. The effect of the ash upon the boiler- and equipment condition will also be studied. (3) A basic evaluation of COM Technology has started at Studsvik Energi-Teknik AB. This study includes bench-scale and pilot projects. The project is said to be a comparison between different fuel-mixture concepts. The Swedish Power Board (SPB) together with Uppsala Kraftvarme AB (UKAB) are conducting a program including equipment testing and full-scale burning of COM in a 200 MW(e) and 315 MW(th) cogenerating plant. So far the bench-scale equipment test has shown a pump suitable for COM transportation and the full-scale burning test has shown the necessity of sootblowers in the combustion chamber and for the convection surfaces. The ambition of this demonstration project in Uppsala is to have the boiler converted for commercial operation by the summer of 1984.

28810 (CONF-810498—(Vol.1), pp 85-112) **US DOE coal-oil mixture combustion program.** Foster, C.B. 1981. NTIS, PC A20/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

The objective of DOE's coal-oil mixture (COM) combustion program is to reduce the domestic dependence on oil by the substi-

tution of coal for an appreciable portion of oil now used in existing boilers and combustors. The COM program consists of DOE in-house and contracted research and development work. This includes two full-scale cost-shared demonstration projects. The history of the DOE COM program and the status of DOE and private sector projects will be reviewed. The COM development program has resulted in many technical accomplishments since its inception. These accomplishments are in the fields of preparation, handling and combustion. Overall, COM has been demonstrated to be a viable and economic alternate fuel for many potential utility and industrial appications. In addition to the research and development sponsored by DOE, commercialization efforts designed to speed the transfer of COM technology to the private sector have been undertaken. The major elements are the commercial COM preparation plants being considered for financial support by DOE. The status of these projects and other commercialization activities, both DOE and private, will be reviewed.

28811 (CONF-810498—(Vol.2), pp 888-892) **Implementation of coal-oil mixture conversion of major fuel burning installations in Massachusetts.** Morgenstern, L. (Massachusetts Executive Office of Energy Resources, Boston). 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

Progress made since the 2nd Symposium by the Massachusetts Executive Office of Energy Resources is highlighted in this article. Unique coal conversion financing, availability of coal-oil-mixtures (COM), and industrial implementation of COM are briefly discussed. (DMC)

28812 (CONF-810498—(Vol.2), pp 893-902) **COM commercialization: the Massachusetts model.** Dietz, L.B. (Public/Private Policy Management, Boston, MA); Sacks, I. 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

Critical to the commercialization of COM is the identification of a potential market. Through a grant funded by the US Department of Energy, Region I, a study was conducted by the Massachusetts Technology Development Corporation of major fuel burning installations (MFBIs) in Massachusetts as defined by the Fuel Use Act (1978). Findings showed a total Btu demand in excess of 23 trillion. Data collected included information on boiler manufacturer, design, and age; present consumption by type and volume; air pollution considerations; and a geographic breakdown to assess proximity to probable sources of supply of COM. An optimum group - coal designed boilers - for COM was identified consisting of 14 coal designed boilers at 9 sites (facilities). Upon completion of the study a mechanism was established whereby the findings of the study could be used to promote commercialization. Using the MFBIs as a nucleus, private and public sector representatives engaged in an effort to explore COM technology to date. The primary goal of having an industrial test of COM is close to fruition. With such a test, the aggregation of a market capable of supporting the construction of a COM preparation plant in Massachusetts becomes more promising.

28813 **(LA—8863-MS) Documentation of the Los Alamos Coal and Utility Modeling System, Version 3.0.** Wolak, F.A.; Bivins, R.L.; Kolstad, C.D.; Stein, M.L. (Los Alamos Scientific Lab., NM (USA)). May 1981. Contract W-7405-ENG-36. 39p. NTIS, PC A03/MF A01. Order Number DE81028086.

The Los Alamos Coal and Utility Modeling System (LACUMS) was developed at the Los Alamos National Laboratory for use in examining effects of governmental regulations on coal-related industries. By altering the associated data base, a user can vary the focus of regional and technological detail and construct a model appropriate to a particular field of inquiry. This report describes and documents LACUMS and provides sample results from the ROCKY3 model, which is solved using LACUMS.

28814 **(UCRL—53121) Possible use of coal in Hawaii, 1980-2000.** Bell, R.B. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 12 Feb 1981. Contract W-7405-ENG-48. 52p. NTIS, PC A04/MF A01. Order Number DE81028266.

This report explores the possibilities for the use of coal in the State of Hawaii. The main section of the report summarizes the nature of the Hawaiian energy sector, considers the possible role coal could play in that sector, and outlines some of the costs and consequences of introducing coal into the State. The technical issues connected with coal use are presented as a set of appendices in support of the main section.

28815 **Possible consequences of restricting the import of oil.** Fishelson, G. (Tel-Aviv Univ., Israel). *Resources and Energy ;* **3**: No. 1, 93-103(Mar 1981).

The study examines the macroeconomic effects of restricting the imports of oil to a country (Israel) where imported oil is the only source of energy. The time frame is the short run and the model used is that of liquid petroleum, implying no substitution among inputs. The conclusion regarding the Israeli economy as of its 1975 production-and-consumption structure is that, in the short run, demand is very inelastic regardless of the scenario hypothesized. 2 references, 3 figures.

2950 Hydrogen And Synthetic Fuels

REFER ALSO TO CITATION(S) 28787

2960 Electric Power

REFER ALSO TO CITATION(S) 28054, 28615, 28740, 28762, 28782, 28784, 28785, 28786, 28788

28816 **(ANL/CNSV-TM—77) Analysis of the fuel and cost effects of interfacing utilities and small-power cogenerators.** Hub, K.; VanKuiken, J.; Marr, W. (Argonne National Lab., IL (USA)). Dec 1980. Contract W-31-109-ENG-38. 32p. NTIS, PC A03/MF A01. Order Number DE81028495.

The potential fuel and cost effects of several cogeneration alternatives are examined. Small coal- and oil-fueled cogenerators were evaluated for their performance in coal- and oil-based utility systems. The impact of interconnected cogenerators on utility systems' fuel use, reliability, and costs is studied. Potential benefits from cogeneration were strongly influenced by cogenerator design options and by characteristics of the utility systems.

28817 **(BNL—29748) Electric sector planning in the northeastern United States: an application of spatial programming.** Meier, P. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 61p. (CONF-810726—1). NTIS, PC A04/MF A01. Order Number DE81026047.

From 9. international conference on operational research; Hamburg, F.R. Germany (23 Jul 1981).

This paper examines the use of spatial programming as a tool for policy analysis for the electric utility sector, in the specific context of the Northeastern United States. Issues examined include offshore siting for coal fired power plants, remote nuclear energy centers, various regulatory schemes for controlling emissions from fossil fueled power plants, conversion of oil burning units to coal, and the extent of a possible utility market for Pennsylvania Anthracite.

28818 **(BNL—51290) Regional Issue Identification and Assessment Program (RIIA): Issue Paper 3, selected institutional aspects of energy development in the northeast.** Bryant, F.C. (ed.). (Brookhaven National Lab., Upton, NY (USA). National Center for Analysis of Energy Systems). Feb 1981. Contract AC02-76CH00016. 64p. NTIS, PC A04/MF A01. Order Number DE81027872.

The three papers presented in this volume discuss selected institutional problems, barriers, or opportunities that can play significant roles in shaping the energy future of the northeast. As used

in this report, institutional issues are defined as those arising from or related to the formal or informal political setting and legal infrastructure within which energy-related plans and decisions are currently made and implemented. This first paper, on Eastern Canada-Northeastern US energy transfers, outlines the prospects for significant Canadian energy sales to the northeast, with particular attention to possible political constraints on such exports and repercussions from them. The second paper, on the socio-political context of nuclear power, describes the current dimensions of the nuclear controversy in the northeast and assesses the theoretical and policy implications of a number of dominant sociological perspectives on this debate. The third paper, on legal aspects of water/energy problems, focuses on water rights conflicts involving energy production uses and discusses the resolution of these conflicts in terms of the riparian doctrine of water rights and use followed by the northeastern states.

28819 **(DOE/CS/20012—T3) National energy peak levelling program. Quarterly report, October-December 1976.** (Engineering Supervision Co., Newport Beach, CA (USA)). 1976. Contract AC03-76CS20012. 28p. NTIS, PC A03/MF A01.

Progress in setting up a remote data entry system which will monitor and record electric power consumption in several large commercial buildings in California is reported. This data will be used to measure the energy conservation potential and socio-economic impacts of load-leveling strategies. (LCL)

28820 **(DOE/EP—0022) Electric power supply and demand for the contiguous United States, 1981-1990.** (Department of Energy, Washington, DC (USA)). Jul 1981. 584p. NTIS, PC A25/MF A01. Order Number DE81027126.

The outlook for electric power supply and demand in the United States for the decade 1981 to 1990 is reviewed from the perspective of reliability and adequacy of service. Electric power supply adequacy as projected for the nine Regional Reliability Council areas of the contiguous United States is reported. Interruptible load data reported by the Councils are reported, and a brief discussion of cogeneration is given. Each of the 27 Electric Regions (sub-areas of the nine Council areas) in the contiguous US are studied in detail. A glossary of terms is given and is followed by several appendices. Appendix A describes very briefly the Council structure, and includes a copy of the ERA-411 Manual, which contains all the items to which the Councils were asked to respond. Appendix A also includes a copy of the letter addressed to the President of the National Electric Reliability Council requesting the Councils to furnish data on cogeneration. Appendix B lists the utilities for which data is included in the report. Appendix C is the Staff Report, Estimated Electric Demand and Supply for Summer 1981, Contiguous United States dated May 1981. (WHK)

28821 **(P—300-81-006) Institutional factors affecting increased power pooling in California.** Sklar, H.; Simon, G.; Fontes, R.A. (California Energy Resources Conservation and Development Commission, Sacramento (USA)). Dec 1980. 109p. California Energy Commission, Sacramento. Order Number DE81903668.

Increased power pooling among California's electric utilities has been shown to offer many significant benefits. Pooling can decrease operating costs, reduce oil consumption, reduce capital expenditures for new facilities, and improve reliability. Since increased pooling opportunities exist, and benefits appear substantial, this study was conducted to determine the causes of currently limited intrastate pooling activities. A possible explanation for the limited pooling in California is that institutional problems serve as barriers. The institutional factors that could either encourage or discourage power pooling are analyzed, actions to overcome or circumvent significant institutional problems are recommended. The report concludes that competitive rivalry between utilities is the most significant institutional barrier to increased pooling. Other important factors include: loss of individual autonomy, uncertain allocation of costs and benefits, insufficient regulatory authority, and the possible burden of less reliable systems. Factors deemed insignificant are: slow resolution of disputes by courts, environmental constraints on new transmission lines, divided regulatory authority, and regulatory rate treatment of pooling. It is recommended that utilities engage in voluntary energy brokering arrangements to overcome competitive rivalry problems in the short-term, while expanding current formal pooling arrangements, involving many more of the states' utilities, as a long-term solution.

28822 **Status of electric power in the Missouri River Basin.** Omaha, NE; Missouri River Basin Commission (1980). 116p. (NP—1903628).

This third Missouri River Basin Commission report on Status of Electric Power in the Missouri River Basin provides information on the status of electric power generation, future needs, and potentials for meeting these needs. Information for this 1980 update is based upon available published information up to and including December 31, 1979. State and federal members of the Missouri River Basin Commission provided information for sections of the report and on legislative activities. Information is included on the planning and projected costs of hydro, nuclear and fossil-fuel power plants, pumped-storage plants, transmission systems, projected power demands, the environmental, socio-economic-cultural impacts of electric power generation, and regulations affecting energy development. (LCL)

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 28881, 28887

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 28343, 28366, 28368, 28369, 28394, 28395, 28405, 28419, 28472, 28513, 28514, 28515, 28516, 28521, 28523, 28778, 28871, 29563

28823 **(CONF-810606—75) Alcohol fuels in the United States.** Stiger, R.R. (EG and G Idaho, Inc., Idaho Falls (USA)). 1981. Contract AC07-76ID01570. 12p. NTIS, PC A02/MF A01. Order Number DE81026013.

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

This paper is to present an overview of the social and technical issues surrounding the production of alcohol for fuels. A brief analysis of the United States Alcohol Program is followed by a discussion of technical and economic factors that affect the production of alcohol fuels.

28824 **(P—500-81-001) Analysis of financial incentives for alcohol fuels. Final report.** (Young (Arthur) and Co., Sacramento, CA (USA)). Jan 1981. 162p. California Energy Commission, Sacramento, CA. Order Number DE81903663.

The purpose of this report is to analyze existing and potential financial incentives for alcohol fuel production and end-use. This analysis provides a basis to evaluate future incentive proposals, beyond strictly financial incentives, which will accelerate the production and use of alcohol fuels in California. The analysis is comprised of several sections including: (1) an overview of the existing alcohol fuels industry; (2) an evaluation of generic incentive measures for alcohol fuels; (3) an implementation plan for alcohol fuel incentives; and (4) a detailed description and cost/benefit analysis of incentive measures recommend for legislative enactment. Some of the incentive recommendations include: legislative modification of state excise tax for alcohol vehicles which would base the tax on energy equivalency; CEC provision of grant or contract fund for analysis of aldehyde emissions from alcohol fuels, and establishment of emission standards; legislative establishment of fuel-type requirements for new vehicles sold in California; CEC development of a timetable for the alcohol conversion of state captive fleets; CEC provision of feasibility study grants to city, county and private fleet operators; and legislative authorization of guaranteed loans to private captive fleet owners for alcohol fuel vehicle conversions.

28825 **Wood and energy in New England: a review and bibliography.** Palmer, L.; McKusick, R.; Bailey, M. Washington, DC; Department of Agriculture (1980). 74p.

A number of fuelwood feasibility studies, fuelwood's role in the national and regional energy picture, wood availability and demand, energy alternatives, and environmental impact are reviewed. An annotated bibliography is included. 130 references.

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

REFER ALSO TO CITATION(S) 28148

28826 (ANL/MHD—80-2) Technical support for open-cycle MHD program. Progress report, July-September 1979. Berry, G.F. (ed.). (Argonne National Lab., IL (USA)). Jun 1981. Contract W-31-109-ENG-38. 123p. NTIS, PC A06/MF A01. Order Number DE81027564.

The support program for open-cycle MHD at the Argonne National Laboratory consists of developing the analytical tools needed for investigation of the performance of the major components in the combined-cycle MHD/steam power system. The analytical effort is centered on the primary components of the system that are unique to MHD and, also, in the integration of these analytical models into a mode for the entire power-producing system. The present project activities include modeling of the secondary combustor, generator, seed deposition, and formation and decomposition of NO. Costing models were developed and used to assess the effect of parameter changes on cost of electricity. Parametric studies were performed to evaluate the performance of the U-25B generator and to support the design of the US U-25B generator. Refinements and improvements to the MHD systems code and executive program are described.

28827 (ANL/MHD—81-6) Comparison of simulated and measured Arnold Engineering Development Center high performance demonstration experiment (AEDC/HPDE) MHD generator performance. El Derini, Z.; Doss, E.D. (Argonne National Lab., IL (USA)). Oct 1980. Contract W-31-109-ENG-38. 55p. NTIS, PC A04/MF A01. Order Number DE81025032.

The MHD generator performance of the High Performance Demonstration Experiment (HPDE) has been analyzed, using the ANL quasi-three-dimensional computer model. Calculations based on the operating conditions of Tests Nos 10 and 14 indicate that for both tests, the trends and magnitudes of the measured data of various electrical and gasdynamic variables are in good agreement with the analytical predictions. The variation of the channel performance as a function of the channel wall temperature, surface roughness, load factor, and magnetic field strength is examined, and numerical examples are given. Performance maps showing channel enthalpy extraction versus isentropic efficiency are generated for range of magnetic field strengths, loading parameters, and electrode surface temperatures. The effect of operating parameters on the boundary layer voltage drops is presented for both cold and hot electrodes walls. A diagnostic data analysis (DDA) procedure has been developed for further verification of the accuracy of the predictions of the quasi-three-dimensional model. In this procedure, the experimental data are used to compute the gasdynamic flow parameters and the boundary layer voltage drop characteristics in terms of $<\sigma>$ and $<1/\sigma>$. The results of this DDA procedure and those of the quasi-three-dimensional model are in good agreement.

28828 Ceramic compound for a magnetohydrodynamic generator electrode. Marchant, D.D.; Bates, J.L. (to Department of Energy, Washington, DC (USA)). French Patent 2,455,812/A/. 28 Nov 1980. Priority date 2 May 1979, United States of America (USA), 13p. (In French).

This invention concerns a ceramic compound electrically conducting at low temperature. Specifically, the invention covers a ceramic compound electrically conducting at low temperature which can be used for making electrodes designed for use in the tunnel of a magnetohydrodynamic generator or as part of the current passage of a magnetohydrodynamic generator electrode intended for use in the high temperature tunnel of a magnetohydrodynamic generator.

28829 (DOE/ET/10805—T1) Development, testing, and evaluation of MHD materials and component designs. Volume II. MHD channel experiments. Final report, 15 October 1973-31 December 1975. Young, W.E.; Turner, A.B. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Nov 1980. Contract AC01-76ET10805. 822p. (FE—1540-29). NTIS, PC A99/MF A01. Order Number DE81026202.

An MHD generator facility for evaluating and developing hot channel materials and structures was constructed with about a 4.0 MW thermal rating and with a gas flow of 1.47 kg/second. A flexible design accommodated various internal sidewall and electrode constructions. The primary objective was to determine the best materials and construction techniques for long life without compromising electrical performance. The facility consisted of an indirect fired air preheater with air supplied from a 350 HP rotary compressor, a combustion system capable of producing a working gas equivalent in all respects to products of combustion of coal and air, fuel and gas supplies with adequate metering facilities, a mixing chamger, provision for seed injection, an MHD generator duct with a conventional iron core magnet of 30,000 gauss maximum field, a back-pressure valve to control duct pressure under all generating conditions, and a gas scrubbing system. Facility design and detailed results from the hot run tests are presented. (WHK)

28830 (DOE/ET/10805—T1(Vol.1)) Development, testing, and evaluation of MHD materials and component designs. Volume I. Executive summary. Final report, 15 October 1973-31 December 1975. Young, W.E. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Nov 1980. Contract AC01-76ET10805. 44p. (FE—1540-29(Vol.1)). NTIS, PC A03/MF A01. Order Number DE81026203.

This report comprises seven volumes, one for each of the major tasks, an appendix volume and the executive summary. The tasks on gas electrical properties, coal combustion, and MHD materials were intended to support the Waltz Mill channel experiments. The conductivity apparatus indicated abnormally high values. The experiments were continued in the Waltz Mill facility. Materials testing indicated that stabilized zirconia should be an acceptable electrode material. A new and improved test facility was designed. Cyclone coal combustors were studied and designs developed for a Waltz Mill size unit and a 25,000 lb/h prototype. The Waltz Mill facility performed in a highly satisfactory manner. Six non-generating and 16 load tests were made on three channels. Following a failure of the air heater tests were run essentially on materials and structures; little power was generated. Electrical leakage, interelectrode and to ground, was a persistent problem. Following the last load test on October 25, 1976, the system was dismantled and reconstruction started to enable testing at the proposed CDIF (Component Development Integrated Facility) conditions (part of the national MHD program). A very successful 127-hour run was made on a pair of US designed and constructed MHD electrode modules in the Soviet Union's U-02 facility, completing Phase I of the US/USSR Cooperative program.

28831 (DOE/ET/10815—60) MHD Coal-Fired Flow Facility. Quarterly technical progress report, October-December 1980. Altstatt, M.C.; Attig, R.C.; Brosnan, D.A. (Tennessee Univ., Tullahoma (USA). Space Inst.). Apr 1981. Contract AC02-79ET10815. 72p. NTIS, PC A04/MF A01. Order Number DE81026507.

Significant activity, task status, planned research, testing, development, and conclusions for the Magnetohydrodynamics (MHD) Coal-Fired Flow Facility (CFFF) and the Energy Conversion Facility (ECF) are reported. On Task 2, fabrication of the disperser plate was completed and the nozzle was connected to the combustor in the CFFF test train. All sections of the diffuser were received and installed in the test train, and fabrication of generator modules one and six was completed. The installation of all radiant furnace refractory components was completed. Five successful runs of a variable pressure coal combustor were made. For the generator, work continued on two and three dimensional codes. Materials activity consisted of refractory applications, generator electrode wear mechanisms study, and construction of the air heater test module. Under Task 3, the two existing air quality monitoring sta-

tions were calibrated and stabilized, and an acoustical radar unit was emplaced. Aquatic monitoring involved the implementation of a field monitoring program and preliminary investigation of phytoplankton population at monitoring sites. Task 7 effort consisted of an extensive analysis of ECF generator performance, and the preparation of detailed test plans for implementing low mass flow LMFO and LMF-1 with regard to all applicable components.

28832 **(DOE/ET/11054—T1) MHD coal combustor technology. Final report, phase II.** (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). Sep 1980. Contract AC22-78ET11054. 213p. NTIS, PC A10/MF A01. Order Number DE81025513.

The design, performance, and testing of a 20-MW coal combustor for scaleup to 50 MW for use in an MHD generator are described. The design incorporates the following key features: (1) a two-stage combustor with an intermediate slag separator to remove slag at a low temperture, thus minimizing enthalpy losses required for heating and vaporizing the slag; (2) a first-stage pentad (four air streams impinging on one coal stream) injector design with demonstrated efficient mixing, promoting high carbon burnout; (3) a two-section first-stage combustion chamber; the first stage using a thin slag-protected refractory layer and the second section using a thick refractory layer, both to minimize heat losses; (4) a refractory lining in the slag separator to minimize heat losses; (5) a second-stage combustor, which provided both de-swirl of the combustion products exiting from the slag separator and simple mixing of the vitiated secondary air and seed; (6) a dense-phase coal feed system to minimize cold carrier gas entering the first-stage combustors; (7) a dry seed injection system using pulverized K_2CO_3 with a 1% amorphous, fumed silicon dioxide additive to enhance flowability, resulting in rapid vaporization and ionization and ensuring maximum performance; and (8) a performance evaluation module (PEM) of rugged design based on an existing, successfully-fired unit. (WHK)

28833 **(DOE/ET/11056—T5) One-dimensional equilibrium-chemistry flow model for coal combustors.** Sforza, P.M.; Smorto, M.; Peter, W. (Polytechnic Inst. of New York, Farmingdale (USA). Aerodynamics Labs.). May 1981. Contract AC01-78ET11056. 108p. NTIS, PC A06/MF A01. Order Number DE81027622.

A quasi-one-dimensional steady flow analysis for high temperature coal combustors is presented. Results for the case of global heat release based on fuel heating value are compared to those obtained with a finite-rate chemical reaction combustor analysis and reasonable agreement between the two is demonstrated. An existing chemical equilibrium computer code is then coupled to the one-dimensional gas dynamic code to improve the accuracy of the required thermodynamic and chemical input data; the coupled code is called COMBUSTOR. The second stage of a coal-fired MHD combustor designed for large-scale operation is modeled by means of the COMBUSTOR code for cases with and without heat transfer, and for varying amounts of potassium carbonate seed injection. Results for combustor exit temperature, composition, velocity, and electrical conductivity from the model are shown to agree well with those obtained in the operational combustor.

28834 **(DOE/ET/15518—4) Key contributions in MHD power generation. Quarterly technical progress report, 1 December 1979-29 February 1980.** Louis, J.F. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Sep 1980. Contract AC01-79ET15518. 177p. NTIS, PC A09/MF A01. Order Number DE81025174.

A separate entry was made in the data base for reports on each of the four tasks: (1) arcing phenomena in MHD generators; (2) open cycle MHD disk generator program; (3) electrode module development and testing; and (4) coal combustion studies. (WHK)

28835 (DOE/ET/15518—4, pp 9-85) **Arcing phenomena in MHD generators.** Sep 1980. NTIS, PC A09/MF A01.

In Key contributions in MHD power generation. Quarterly technical progress report, 1 December 1979-29 February 1980.

Preparations for the axial breakdown experiment on the new inter-electrode are complete except for final assembly of the channel. A small (1/8th MW) combustion facility has been designed and fabricated in this reporting period and the combustor operated successfully. This new equipment should allow several small-scale but useful experiments to be performed at a relatively rapid pace. Design studies have been made regarding the use of enlarged plasma-sprayed sidewall modules, both for our forthcoming slagging experiments and for the MHD generator under design (Channel II). The predicted axial breakdown limits are encouraging, but test results are needed to validate the analysis. Slag flow simulation experiments are being directed toward obtaining a detailed set of data for non-isothermal layers and toward obtaining visual records of the gas and viscous film flow behavior. A stability model of the slag layer including viscosity gradients has been completed and results presented for conditions typical of MHD flows and of the simulation experiments. An analysis of local gravity-driven instabilities is also presented.

28836 (DOE/ET/15518—4, pp 86-116) **Open cycle disk generator program.** Sep 1980. NTIS, PC A09/MF A01.

In Key contributions in MHD power generation. Quarterly technical progress report, 1 December 1979-29 February 1980.

An experimental study of the effects of thermal and velocity nonuniformities is performed in an equilibrium plasma for a range of Hall parameters. An electrodeless MHD disk generator with radial flow is chosen as the ideal geometry for these experiments. By introducing equally spaced cold blades in the flow, it is possible to create well defined two-dimensional wake nonuniformities with strong variations of the plasma properties in the direction normal to the magnetic field and the flow. This type of nonuniformity and orientation theoretically provides the strongest reduction of Hall coefficient and effective conductivity for high values of Hall parameter. This degradation is controlled by both the level of nonuniformities and the value of the ideal Hall parameter. The results provide basic quantitative information about the effect of conductivity and velocity nonuniformities on the performance of equilibrium MHD generators over a wide range of Hall coefficients, between 2 and 7. Reduction formulae are established between the effective and ideal Hall parameters for different levels of nonuniformities intensities. Theoretical predictions are derived from a detailed two-dimensional electrodynamic analysis and a simplified engineering model based on a generalization of Rosa's layer model.

28837 (DOE/ET/15518—4, pp 117-131) **Electrode module development and testing.** Sep 1980. NTIS, PC A09/MF A01.

In Key contributions in MHD power generation. Quarterly technical progress report, 1 December 1979-29 February 1980.

The progress of experiments concerned with insulator breakdown voltage at elevated temperature for hot-pressed silicon nitride and sintered magnesium aluminate is reported. Other reported experiments deal with diffusion of an iron tracer in alumina. Design, fabrication and testing of a traversing probe system is described; the probe is intended to obtain total head and plasma radiation data from within the nozzle and combustor of the USSR/IVTAN U-25B facility.

28838 (DOE/ET/15518—4, pp 132-174) **Kinetic modeling of a two-stage combustor.** Sep 1980. NTIS, PC A09/MF A01.

In Key contributions in MHD power generation. Quarterly technical progress report, 1 December 1979-29 February 1980.

Research on coal combustion kinetics and ash behavior relevant to two-stage MHD combustors and an investigation of the mixing and flow aerodynamics of a high swirl geometry second stage are reported. Preliminary results indicate excellent performance of a new brass centripeter for separation of soot and char in pyrolysis experiments. Numerical results from an updated MHD coal combustor model are also presented, for both single-stage and two-stage combustors; experimental data from BCURA is used for corroboration. The model is useful in selecting optimal combinations of fuel equivalence ratio, temperature, and reaction time conditions. Current work to further upgrade this model is discussed. The progress of experiments on the high swirl combustor simulation rig is presented, including the development of the diagnostic techniques. Further work with the code SHAPE involved modifications to permit radially variable input velocity profiles. (WHK)

28839 **(DOE/ET/15602—T5) MHD air-heater technology development. Technical progress report, January 1, 1981-March 31, 1981.** (FluiDyne Engineering Corp., Minneapolis, MN (USA)). Apr 1981. Contract AC01-80ET15602. 44p. NTIS, PC A03/MF A01. Order Number DE81026605.

Progress on the technology development of the directly-fired high temperature air heater (HTAH) for MHD power plants is reported. The major objectives of the work under task 1 are (1) to identify and encourage development of ceramic materials which are resistant to seed/slag, high temperature, and thermal cycling and to evaluate their performance and life in the HTAH service environment; and (2) to continue development of a HTAH materials data base which will contain the materials data needed to design and construct larger scale HTAH's. The major objectives of the work under task 2 are: (1) to perform long term tests of materials for and operability of the HTAH cored brick matrix; (2) to perform long term tests of materials for and performance and reliability of HTAH valves; and (3) to coordinate the test programs at FluiDyne, MSU, and other organizations to insure that testing results are useful to the HTAH development program. The major objectives of the work under task 3 are: (1) to identify development needs through design studies of full-scale HTAH systems; and (2) to study HTAH performance and system response in order to identify control and instrumentation needs. (WHK)

28840 **(DOE/ET/15611—T2) High-magnetic-field MHD-generator program. Quarterly report, January 1, 1981-March 31, 1981.** (Stanford Univ., CA (USA). High Temperature Gasdynamics Lab.). Apr 1981. Contract AC01-80ET15611. 80p. NTIS, PC A05/MF A01. Order Number DE81025560.

Progress in an experimental and theoretical program designed to investigate MHD channel phenomena which are important at high magnetic fields is reported. The areas of research include nonuniformity effects, boundary layers, Hall field breakdown, the effects of electrode configuration and current concentrations, and studies of steady-state combustion disk and linear channels in an existing 6 Tesla magnet of small dimensions. In the study of the effects of nonuniformities, experiments have been performed to test a multi-channel, fiber optics diagnostic system that yields time-resolved temperature profiles in an MHD channel. For the study of magneto-acoustic fluctuation phenomena, a one-dimensional model has been developed to describe the performance of a non-ideal MHD generator with a generalized electrical configuration. The installation of the hardware for the data acquisition and reduction of the laser Doppler velocimeter data, to be used in the study of turbulence suppression in a magnetic field, has been nearly completed. A two-dimensional MHD computer code has been developed which predicts the dependence on electrode and insulator dimensions of the onset of interelectrode Hall field breakdown. Calculations have been performed of the effects of nonuniformities on the flow and electrical behavior of baseload-sized disk generators.

3004 Thermionic Converters

28841 **(TE—4258-247-81) DOE advanced thermionic technology program. Progress report No. 46, January, February, March 1981.** (Thermo Electron Corp., Waltham, MA (USA)). 1981. Contract AC02-76ER11291. 58p. NTIS, PC A04/MF A01. Order Number DE81027307.

The primary long-term goal is to improve thermionic performance to the level that thermionic topping of fossil-fuel powerplants becomes technically possible and economically attractive. An intermediate goal is to operate a thermionic module in a powerplant during the mid-1980's. A short-term goal is to demonstrate reliable thermionic operation in a combustion environment. This report covers progress made during the three-month period from January through March 1981. During this period, significant accomplishments include: (1) continuing stable output from the combustion test of the one-inch diameter hemispherical silicon carbide diode at an emitter temperature of 1730 K for a period of over 6400 hours; (2) demonstration of an additive oxygen effect in a research diode with a cesium-graphite reservoir located in the collector; (3) preliminary testing of the four-diode module; and (4) evaluation of a research diode with ZrO_2-Mo cermet electrodes.

3005 Fuel Cells

REFER ALSO TO CITATION(S) 29163

28842 **(BNL—29788) Oxygen reduction on carbon-supported platinum fuel-cell electrodes in H_3PO_4.** McBreen, J.; Olender, H.; Srinivasan, S. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 11p. (CONF-8105105—2). NTIS, PC A02/MF A01. Order Number DE81027303.

From Symposium on electrocatalyis; Minneapolis, MN, USA (10 May 1981).

The reduction of oxygen on carbon supported fuel cell electrodes was investigated in phosphoric acid electrolytes in the concentration range of 85% to 101% and at temperatures from 25° to 180°C. In purified acid the Tafel slope in the potential region of 0.7 to 0.9 V RHE is ~ 120 mV/decade and is invariant with temperature. The activation energy for oxygen reduction is between 8 kcal and 13 kcal/mole. In impure 101% electrolyte the Tafel slope increases from a value of 85 mV/decade at 80°C to 105 mV/decade at 180°C and the activation energy is 18.29 kcal/mole. The major discrepancies in the literature can be rationalized on the basis of impurity effects. In pure electrolytes, the kinetic parameters on smooth platinum and high area carbon supported platinum are the same.

28843 **(CONF-8106122—(Absts.)) National fuel cell seminar. Program and abstracts.** (Courtesy Associates, Inc., Washington, DC (USA)). 1981. Contract AC01-78ET11454. 156p. NTIS, PC A08/MF A01. Order Number DE81026688.

From National fuel cell seminar; Norfolk, VA, USA (23 Jun 1981).

Abstracts of 46 papers presented at the meeting are included. Session topics include fuel cell applications, phosphoric acid fuel cell technology, fuel cell systems, applied research, advanced fuel cells, and special applications. (WHK)

28844 **(DOE/CS/40004—T2) Fuel cells.** (TRW, Inc., McLean, VA (USA)). Jul 1977. Contract AC03-77CS40004. 9p. NTIS, PC A02/MF A01.

The development, operation, and characteristics of fuel cells for electrical generation are discussed, and the technology and status of first-generation and second-generation fuel cells are reviewed. The economics of fuel cells is considered. (WHK)

28845 **(DOE/ET/11276—T4) Fuel-cell research on second-generation molten-carbonate systems. Project 9105 quarterly technical progress report, October 1-December 31, 1977.** (Institute of Gas Technology, Chicago, IL (USA)). Mar 1978. Contract AC02-78ET11276. 63p. (SAN—1735-1). NTIS, PC A04/MF A01.

The objectives of the FY 1978 program are to: (a) improve the performance and endurance of the molten carbonate fuel cell; and (b) develop cost-effective cell components. The required effort is subdivided into three tasks: (1) Cell and component development: improved components and cost-effective fabrication processes will be developed. This will include developing stable anode structures and improved electrolyte structures that can be fabricated by cost-effective processes. (2) Fuel cell electrolyte optimization: new melt compositions will be tested in laboratory- and bench-scale cells. Supporting information necessary for electrolyte section and for understanding the processes occurring in these systems will be obtained by developing models to describe cell performance and by electrochemical measurements. (3) Cell operation at high pressure: molten carbonate fuel cells will be operated at high pressure to identify and provide solutions to cell decay mechanisms and to identify problems associated with operating these cells at high pressures. Progress is reported. (WHK)

28846 (DOE/NASA/0208—2) Stabilizing platinum in phosphoric acid fuel cells. Second quarterly report, April-June 1981. Remick, R.J. (National Aeronautics and Space Administration, Washington, DC (USA); Institute of Gas Technology, Chicago, IL (USA)). Jul 1981. Contract AI01-80ET17088. 34p. (NASA-CR—165377). NTIS, PC A03/MF A01. Order Number DE81027844.

The objective of this project is to develop a carbon substrate for use in fabricating phosphoric acid fuel cell electrodes which will stabilize the platinum catalyst in a high-surface-area condition by retarding the sintering of small platinum crystallites. The experimental approach is to form etch pits in the carbon by oxidizing the carbon in the presence of a metal oxide catalyst, remove the metal oxide by an acid wash, and then deposit platinum in these pits. The experimental results from the first quarter of the project confirm the formation of etch pits. During the second quarter, both unmodified and catayticaly oxidized supports were impregnated with high-surface-area platinum (40 to 100 m^2/g) and fabricated into flag-type test electrodes. The platinum sintering rates were determined for these electrodes under conditions simulating those encountered at the cathode of a phosphoric acid fuel cell (650 mV RHE, 100% H_3PO_4, 190°C). In general, the platinum sintering rates were lower for supports modified by catalytic oxidation.

28847 (DOE/NASA/12726—7) Pumping power considerations in the designs of NASA-Redox flow cells. Hoberecht, M.A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jun 1981. Contract AI04-80AL12726. 11p. (NASA-TM—82598). NTIS, PC A02/MF A01. Order Number DE81028789.

The NASA-Redox Energy Storage system uses two fully soluble redox couples as anode and cathode fluids. Both fluids are pumped through a redox cell, or stack of cells, where the electrochemical reactions take place at porous carbon felt electrodes. Pressure drop losses are therefore associated with this system due to the continuous flow of reactant solutions. The exact pressure drop within a redox low cell is directly dependent on the flow rate as well as the various cell dimensions. Pumping power requirements for a specific set of cell operating conditions can be found for various cell geometries once the flow rate and pressure drop have been determined. Since these pumping power requirements contribute to the overall system parasitic energy losses which must be minimized, the choice of cell geometry becomes critical. Pressure drop data for six different cell geometries of various flow port, manifold, and cavity dimensions are presented and discussed.

28848 (LBL—12638) Electrode surface chemistry: FY 1980 annual report. Ross, P.N. Jr. (Lawrence Berkeley Lab., CA (USA)). Sep 1980. Contract W-7405-ENG-48. 15p. NTIS, PC A02/MF A01. Order Number DE81028088.

The objective of this research is to develop the physical and chemical understanding of oxygen-platinum-alloy ligand interaction necessary for the rational selection of alloying components. The experimental approach combines the study of the interaction of the oxygen molecule with bimetallic surfaces in vacuum and in aqueous solution in a single apparatus. This apparatus combines classical electrochemical methods together with the analytical methods of surface science: low energy electron diffraction (Leed), Auger electron spectroscopy (AES), photoemission spectroscopy, (XPS and UPS), and thermal desorption mass spectroscopy (TDS). The following four tasks were set up: 1) studies of modified Pt surfaces in acidic solutions; 2) studies of oxygen adsorption on modified Pt surfaces; 3) new modified Pt electrocatalysts; 4) new acid electrolytes for fuel cells. Construction of the experimental apparatus was divided into two independent modules which could be assembled, tested, and used separately in the experiments. The first module with the LEED and AES was completed and experiments related to the Task 1 program were conducted. This study on the electrosorption of hydrogen and hydroxyl groups on Pt single crystals was completed in FY'80. The past year has been devoted to the construction of the second module and the fabrication work is nearly complete. Upon completion, oxygen adsorption experiments will be conducted.

28849 (TR—123) Modeling of coal gasification for fuel-cell utilization. Technical progress report. Finson, M.L.; Lewis, P.F.; Simons, G.A.; Wilemski, G.; Wray, K.L. (Physical Sciences, Inc., Woburn, MA (USA)). Apr 1978. Contract AC03-76SF90396. 52p. NTIS, PC A04/MF A01. Order Number DE81028749.

Recent progress on a program to construct and exercise computer models for potential combined coal gasification/fuel cell systems is summarized. An improved one-dimensional model for entrained flow gasifiers is reported. The key feature of this model is a new description for coal char reactivities, which accounts for the distribution of pore sizes and the role of large feeder pores. The entrained flow code also describes devolatilization, gas phase chemistry, and the various types of energy transport. Preliminary comparisons with results of laboratory-scale entrained flow experiments are shown. Several aspects of fuel cell performance are also examined. The distribution of heat sources and sinks within a cell is discussed in some detail. The heat release is shown to be strongly exothermic at the cathode, and almost as endothermic at the anode. However, the required heat flux can be transported across the tile by temperature differences of only about 2°C. Finally, the potential effects of methane reactivity at the anode are outlined by considering the opposite limits whereby methane is in complete equilibrium or is inert. If methane is reactive, it tends to be produced at the anode inlet, rather than consumed, for typical gasifier off-gas compositions. On the other hand, if CH_4 is unreactive, significantly greater amounts of H_2O must be added to the anode stream to prevent carbon deposition. Reliable estimates for methane kinetic rates will be required to completely resolve the methane conversion issue, which can strongly affect overall cell energy efficiency.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 28778, 28794, 28795, 28796, 28797, 28798, 28799, 28800, 28801

28850 (DOE/CS/40004—T6) National undertakings to improve the efficiency of end use of energy in the United States. (TRW Systems Group, McLean, VA (USA)). 15 Apr 1977. Contract AC03-77CS40004. 50p. NTIS, PC A03/MF A01.

The following topics are covered: improving the efficiency of the US transportation system; upgrading new and existing buildings; cogeneration of electricity and process steam; fuel switching in industry; and fuel switching in the electric utilities.

3201 Buildings

REFER ALSO TO CITATION(S) 28460, 28471, 28473, 28744, 28819

28851 (ANL/CNSV-TM—68) Site and Neighborhood Design (SAND): development of simplified automated building thermal load procedures. Phase I. Diderrich, G.T.; Hrabak, R.A. (Argonne National Lab., IL (USA)). Jul 1980. Contract W-31-109-ENG-38. 116p. NTIS, PC A06/MF A01. Order Number DE81027138.

One of the main objective of the Site and Neighborhood Design (SAND) program is to provide land developers, architects, and planning professionals with the necessary analytical tools and technical means to examine energy options at the preconstruction and first stages of aggregate building development. One type of tool is simplified procedures for estimating the thermal loads of buildings. This report describes Phase I of the SAND program: the acquisition, implementation, and documentation of the thermal-load procedures and associated data files actually used by the five SAND participants.

28852 (BNL—29625) Design, operation and performance of a ground coupled heat pump system in a cold climate. Metz, P.D. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 8p. (CONF-810812—25). NTIS, PC A02/MF A01. Order Number DE81024257.

From IECEC conference; Atlanta, GA, USA (9 Aug 1981).

A small, well insulated house on the BNL site has been equipped with a ground coupled heat pump space conditioning system. This paper describes the design and installation of the system and presents performance data for the first winter of operation, October 1980 to March 1981. The heating system heat requirement for the 3 bedroom 104 m^2 (1120 ft^2) house was measured to be about 9.5 x 10^6 J/C-day (5000 Btu/F-day) by using resistance heating of the house between February and May 1980. This leads to a design heat rate of about 3.4 kW (11.5 x 10^3 Btu/hr) at the local design temperature of -12 C (10 F). Based upon the underground heat flow computer program GROCS developed at BNL, an antifreeze filled serpentine earth coil was designed to just meet the building's design heating needs with an average brine temperature never less than 7 C (20 F). The 155 m (507 ft) long, 1.2 m (4 ft) deep serpentine earth coil made from nominal size 1-1/2 in. (actual O.D. 4.633 cm) medium density polyethylene pipe was installed by a local plumbing contractor using two different chain driven trenchers. A commercially available water-to-air heat pump was used with minor modifications. System performance has been monitored using killowat-hour meters, a Btu-meter, and a datalogger-microcomputer data acquisition system. The house temperature has been kept between 21 and 23 C (70 and 74 F) all winter despite outdoor temperaure as low as -24 C (-11 F). During the period November 20, 1980 to March 2, 1981 while the outdoor temperature averaged -2 C (28 F), the system extracted approximately 10.2 x 10^9 J (9.7 x 10^6 Btu) from the ground with an almost constant heat pump COP (coefficient of performance) averaging about 2.3 and a system COP of 2.2. No resistance heating was used. Ways in which the system could be improved and this efficiency significantly increased are discussed.

28853 **(CONF-810672—1) Computer-aided heat-pump design and optimization.** Fischer, S.K.; Rice, C.K. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 4p. NTIS, PC A02/MF A01. Order Number DE81024965.

From DOE heat pump contractors' program integration meeting; McLean, VA, USA (2 Jun 1981).

The objectives of this project are to develop and demonstrate analytical methods to predict the performance of existing and proposed heat pumps; to develop and demonstrate computer programs to serve as tools for the design and optimization of high efficiency heat pumps. A computer model of electric-motor-driven heat pumps was developed to provide detailed analyses of the performance of existing or proposed heat pumps. To the extent possible, the model is based on the physical principles underlying the processes and on basic correlations, with minimal use of empirical correlations. This approach was adopted so as to give the model maximum flexibility; to allow its use for analyzing design concepts that depart from current practice. The computer program is organized to facilitate its use by engineers who want to concentrate on a heat pump design, not a computer program. The heat pump model was connected to an optimization program in order to maximize the predicted heating efficiency by simultaneously varying ten design parameters to find the combination giving the highest COP at a specified heating capacity. Technical accomplishments to date are described.

28854 **(CONF-810672—2) Laboratory determination of frosting and defrosting losses for a high-efficiency air-source heat pump.** Miller, W.A.; Ellison, R.D. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 4p. NTIS, PC A02/MF A01. Order Number DE81023218.

From DOE heat pump contractors' program integration meeting; McLean, VA, USA (2 Jun 1981).

Tests were performed to detail system and component performance data, to quantify the dynamic losses, and to seek and evaluate methods for reducing these losses. A high efficiency split-system heat pump was installed in two separate air loops, with one loop housing the indoor unit and the other housing the outdoor unit. Calculations of the heat pump's performance based on air-side measurements were within 3% of that based on refrigerant side measurements. Refrigerant flow rate was measured using a turbine flow meter. Refrigerant temperatures and pressures were measured with thermocouples and pressure transducers connected at various strategic locations in the refrigeration circuit. Electric power consumption for all motors was measured with Thermal-watt converters. Performance of the heat pump was measured under steady-state, dehumidification, and frosting-defrosting conditions with major emphasis placed on the dynamic frosting operation of the system. The study encompassed an evaluation of the system and component performance for ambient temperature levels of 8.3, 4.4, 1.7, -1.1 and -8.3°C and for discrete humidity levels ranging from 50 to 90%.

28855 **(CONF-810672—3) Alternative heat pump cycle studies.** Creswick, F.A. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 4p. NTIS, PC A02/MF A01. Order Number DE81024983.

From DOE heat pump contractors' program integration meeting; McLean, VA, USA (2 Jun 1981).

The objective of this study is to conceive and evaluate alternative heat pump cycles for space conditioning applications that offer improved performance or the option to use a non-chlorofluorocarbon (CFC) working fluid. Heat pump cycles that have been or will be examined in this study include various air-cycle systems, the Stirling cycle, and an ejector cycle, but no specific mechanical configurations have been developed. The concept is discussed. Results of preliminary studies on the air cycles and the Stirling heat pump are discussed briefly. Ejector heat pump studies are at a very preliminary stage and no conclusions have been made. (MCW)

28856 **(CONF-810672—5) Investigation of direct expansion in ground-soruce heat pumps.** Kalman, M.D. (Oak Ridge National Lab., TN (USA); E-Tech, Inc., Atlanta, GA (USA)). 1981. Contract W-7405-ENG-26. 6p. NTIS, PC A02/MF A01. Order Number DE81024139.

From DOE heat pump contractors' program integration meeting; McLean, VA, USA (2 Jun 1981).

A fully instrumented subscale ground coupled heat pump system has been developed and built. This experimental apparatus has been used to test and obtain data on three different earth heat exchanger configurations under heating conditions (ground cooling). Various refrigerant flow control and compressor protection devices have been tested for their applicability to the direct expansion system. Undisturbed earth temperature data have been acquired at various depths. The problem of oil return at low evaporator temperatures and low refrigerant velocities has been addressed. An analysis has been performed to theoretically determine what evaporator temperature can be expected with an isolated ground pipe configuration with given length, pipe size, soil conditions and constant heat load. Technical accomplishments to date are summarized.

28857 **(CONF-810672—6) Light-commercial Brayton/Rankine space-conditioning system.** Friedman, D.; Trester, K.; Cowell, W. (Oak Ridge National Lab., TN (USA); AiResearch Mfg. Co., Torrance, CA (USA)). 1981. Contract W-7405-ENG-26. 7p. NTIS, PC A02/MF A01. Order Number DE81024137.

From DOE heat pump contractors' program integration meeting; McLean, VA, USA (2 Jun 1981).

A heat-actuated space conditioning system that provides more efficient use of natural gas developed for 26.4- to 87.8-kW-(7.5- to 25-ton) commercial applications is described. The system consists of a subatmospheric, natural-gas-fired, Brayton-cycle engine that drives a Rankine-cycle heat pump. A centrifugal Freon compressor is driven directly from the Brayton engine rotating group through a permanent-magnet coupling. Unique features that offer high life-cycle performance include a hermetically sealed magnetic coupling, air foil bearings, an atmospheric in-line combuster, and a high-temperature recuperator. Predicted overall engine efficiency is 27% and predicted overall coefficient of performance (COP) at the energy source is 1.0 in cooling and 1.2 in heating. Cycle description, system performance predictions, energy savings and payback cost analysis, hardware development, and the program status are discussed.

28858 **(CONF-810672—7) Well-water-source heat pump field performance study.** Dougall, R.S. (Oak Ridge National Lab., TN (USA); Pittsburgh Univ., PA (USA). Dept. of Mechanical Engineering). 1981. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01. Order Number DE81024136.

From DOE heat pump contractors' program integration meeting; McLean, VA, USA (2 Jun 1981).

The objective of this study is to obtain and analyze data pertaining to the field performance characteristics of two well-water-source heat pumps (WWSHPs) which are installed in two residences located in rural south-central Pennsylvania. These were existing single-family residences which were retrofitted with the WWSHPs. The heat pumps will supply heating in the winter and cooling during the summer. The heat pump installations are being instrumented with an automated data gathering system which will allow the performance of the systems to be evaluated. The first major aim of this project is to evaluate the data obtained so that seasonal performance factors and energy consumption characteristics of the WWSHPs may be evaluated. The second major aim of this project is to develop a mathematical model that simulates the actual performance satisfactorily and then to use this model to compare WWSHPs with other heating and cooling systems. Results to date have been the design of the instrumentation and data acquisition system and obtaining a preliminary design of the control logic and data reduction software for the minicomputer to be located at the sites.

28859 **(CONF-810672—9) Conduct a state-of-the-art survey of existing knowledge for the design of ground-source heat pumps.** Ball, D.A. (Oak Ridge National Lab., TN (USA); Battelle Columbus Labs., OH (USA)). 1981. Contract W-7405-ENG-26. 6p. NTIS, PC A02/MF A01. Order Number DE81024084.

From DOE heat pump contractors' program integration meeting; McLean, VA, USA (2 Jun 1981).

Historic and current methods for designing ground-coil heat pumps with emphasis on European and North American experiences are discussed. Approximately 27 individual design and performance evaluation methods were studied with most of them employing computer techniques. Modeling categories include steady-state analytical and transient analytical; lumped parameter; finite difference; and finite element in 1, 2, and 3 dimensions. A discussion of each is presented. (MCW)

28860 **(CONF-810672—11) Assessment of I.C. engines as drivers for heat actuated heat pumps.** Burke, J.C.; Teagan, W.P.; Gott, P.G. (Oak Ridge National Lab., TN (USA); Little (Arthur D.), Inc., Cambridge, MA (USA)). 1981. Contract W-7405-ENG-26. 6p. NTIS, PC A02/MF A01. Order Number DE81024086.

From DOE heat pump contractors' program integration meeting; McLean, VA, USA (2 Jun 1981).

The objective of this program is to assess the present suitability and future potential of gas-fired and oil-fired internal combustion (I.C.) engines for use in heat-actuated heat pumps for space conditioning applications. The study focuses on drives for residential and light commercial machines up to 100 KW output - or approximately 50 HP engine input. A conceptual design identifying major generic elements was prepared to serve as a basis for estimating performance first cost and maintenance costs. A review of prior experiences with I.C. engines with heat pumps used in similar situations was conducted. Capital costs and maintenance costs were estimated and diesel and spark ignition engine efficiencies were determined. Institutional and operational considerations were identified. (MCW)

28861 **(CONF-810672—13) Heat pump R and D at Oak Ridge National Laboratory.** Ellison, R.D.; Creswick, F.A. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 4p. NTIS, PC A02/MF A01. Order Number DE81024121.

From DOE heat pump contractors' program integration meeting; McLean, VA, USA (2 Jun 1981).

The objective of this program is to develop technology, concepts, and design tools to improve the performance, reliability, and cost-effectiveness of electric heat pumps using air and alternative heat sources such as well water or earth-coupled heat exchangers. Laboratory studies of air-source heat pumps, conducted to date, include system and component performance evaluations at steady state and under frosting conditions. A computer model of electric motor driven heat pumps was developed to explore the practical limits of steady-state heating efficiency of conventional air-source heat pumps, and to demonstrate an approach to computer-aided heat pump design techniques. Other analytical projects include scoping calculations of alternative heat pump systems, such as air-cycle heat pumps and electric motor driven Stirling heat pumps (not Stirling engine driven vapor compression cycles). Computer programs were written to model the expected performance of vertical-pipe ground-coupled heat exchangers, and for the detailed performance analysis of air-to-refrigerant heat exchangers with complex refrigerant circuiting by calculating the performance of each tube of the heat exchanger individually. A capability was developed for estimating seasonal performance factors for air-source heat pumps using hour-by-hour calculations with empirical temperature dependent degradation factors. Technical accomplishments are described.

28862 **(CONF-810672—14) Diaphragm Stirling engine heat-actuated heat pump development.** Ackermann, R.A.; Swenson, P. (Oak Ridge National Lab., TN (USA); Mechanical Technology, Inc., Latham, NY (USA); Consolidated Natural Gas Research Co., Cleveland, OH (USA)). 1981. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01. Order Number DE81024076.

From DOE heat pump contractors' program integration meeting; McLean, VA, USA (2 Jun 1981).

The objective of this program is to develop and demonstrate the performance of a diaphragm Stirling engine heat-actuated heat pump power module. The power module, consisting of a free displacer, resonant Stirling engine, hydraulic transmission, and resonant Rankine refrigerant (F-22) compressor, embodies several innovative concepts in free-piston Stirling engine heat pump design that will advance the state of the art of this technology. Progress is reported in three areas of the program. First, a compressor/engine matching analysis and a stability analysis have shown that the power module, which is representative of a two-degree-of-freedom resonant system, will operate stably over the full range of heat pump conditions. Second, a compressor design has evolved that has met criteria for performance and cost; and third, tests employing a hydraulic simulator test rig has shown that the transmission losses are less than had been predicted, and that properly designed and fabricated diaphragms can attain long life.

28863 **(CONF-810672—19) Organic absorption gas-fired residential heat pump.** Murphy, K.P. (Oak Ridge National Lab., TN (USA); Allied Corp., Morristown, NJ (USA)). 1981. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01. Order Number DE81024131.

From DOE heat pump contractors' program integration meeting; McLean, VA, USA (2 Jun 1981).

The development program of a system utilizing a new absorption pair, R133a (CF_3CH_2CL) as the refrigerant, and ETFE (ethyltetra-hydrofurfurylether) as the absorber fluid, is described. A diagram of the basic configuration is shown. The cooling mode (refrigerant is evaporated chilling the glycol solution which circulates to the house coil) and the heating mode (the heat is rejected by both the absorber and condenser to the glycol solution which then goes to the home) are discussed. Six units of an early hardware design were constructed and tested. Two of these units were placed in home heating service during the 1980-81 season. A market evaluation of the business potential of the absorption system was made identifying location and size of the likely market for such a system. A performance simulation analysis was performed for seven cities in the US. From these, general characteristics of the areas having the greatest performance benefits were established.

28864 **(CONF-810672—20) Development and demonstration of an ammonia-water absorption heat pump.** Merrick, R.H. (Oak Ridge National Lab., TN (USA); Arkla Industries, Inc., Evansville, IN (USA)). 1981. Contract W-7405-ENG-26. 4p. NTIS, PC A02/MF A01. Order Number DE81024126.

From DOE heat pump contractors' program integration meeting; McLean, VA, USA (2 Jun 1981).

Development of a residential air-source ammonia-water absorption heat pump designed to operate in the heating mode only and deliver its output as hot water is described. A prototype unit was developed and three life test and three field test units will be operating in a northern climate during the '81/'82 winter. Proto-

type specifications are 50,000 Btuh input, 125°F supply water, 105°F return water, COP 1.25 @ 47°F ambient and 1.12 @ 17°F ambient.

28865 **(DOE/CE/20418—2) Minimum Energy Dwelling mini-workbook.** (Southern California Gas Co., Los Angeles (USA); Mission Viejo Co., CA (USA); Burt-Hill-Kosar-Rittelmann Associates, Washington, DC (USA)). Jul 1981. Contract AC03-78CS20418. 89p. NTIS, PC A05/MF A01. Order Number DE81027689.

A condensed version of the original Minimum Energy Workbook is presented. The total scope of residential energy conservation is discussed particularly for houses constructed in Southern California, but may apply with suitable modification in other climates. The original 50% energy reduction goal in the MED houses has been successful and the reduction is attributed to the appropriate use of design and construction concepts presented in this workbook. (MCW)

28866 **(DOE/CS/10757—T1) Variable interval time/temperature (VITT) defrost-control-system evaluation.** (Science Applications, Inc., La Jolla, CA (USA)). 12 Aug 1980. Contract AC03-79CS10757. 101p. NTIS, PC A06/MF A01.

Two variable-interval-time/temperature (VITT) heat pump defrost control systems are analyzed to determine if systems manufactured by Honeywell and Ranco qualify for credit for heat pumps with demand defrost control. The operation of the systems is described. VITT controls are not demand defrost control systems but utilize demand defrost control as backup systems in most Ranco models and all Honeywell models. The evaluations and results, intended to provide DOE information in making its determinations regarding credits for the control systems are discussed. The evaluation methodology utilizes a modified version of the Heat Pump Seasonal Performance Model (HPSPM) and the important modifications are discussed in Appendix A. Appendix B contains a detailed listing and discussion of the HPSPM output. (MCW)

28867 **(DOE/CS/20057—T4) Energy analysis for a sample building by the proposed ASHRAE simplified method.** Kasuda, T.; Ishii, K. (National Bureau of Standards, Washington, DC (USA)). Jan 1981. Contract AC01-78CS20057. 265p. NTIS, PC A12/MF A01. Order Number DE81027189.

Data are presented illustrating an energy analysis of a sample office building located in Washington, DC using the proposed ASHRAE simplified method. Calculations for space load are presented in Chapter B. The calculations for the energy distribution systems (air conditioning, outdoor air control, humidity control, air-duct systems) are given in Chapter C. Chapter D covers equipment system calculations, and calculations for the annual energy consumption for air conditioning are given in Chapter E. (MCW)

28868 **(DOE/CS/20057—T5) Energy analysis sample building data.** (American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., New York. Subcommittee for Simplified Energy Analysis). Mar 1981. Contract AC01-78CS20057. 34p. NTIS, PC A03/MF A01. Order Number DE81027188.

Sample building data for energy calculations necessary for the comparative analysis between the proposed energy calculation procedure and the procedures using comprehensive hourly simulation of HVAC systems are presented. The comparison calculation includes data for the terminal reheat system, double-duct system, heat reclaim system, and standard VAV system for a hypothetical 20-story office building in Washington, DC. Each is evaluated in conjunction with electric centrifugal chiller and gas-fired boiler. (MCW)

28869 **(DOE/CS/20057—T6) Proposed simplified energy calculation procedure for use in energy conservation standards activities.** Kasuda, T. (American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., New York). Mar 1981. Contract AC01-78CS20057. 90p. NTIS, PC A05/MF A01. Order Number DE81027190.

In order to circumvent various difficulties involved in using the computer simulation-based building energy analysis procedure, TC4.7 developed a simplified manual procedure suitable for commercial buildings (internal and solar heat gain dominating over the envelope conduction heat transfer). The procedure is a modified bin method originally developed by Carrier Corporation and has been compared favorably with seven computer simulation-based procedures, at least for a typical office building analysis, for Washington, DC climate. This report describes the basic principle of the proposed procedure, sample building data, and the results of parallel calculations with seven computer simulation-based energy analysis programs.

28870 **(DOE/CS/21693—T1) Technical analysis and review: NAHB thermal performance guidelines.** (Booz, Allen and Hamilton, Inc., Bethesda, MD (USA)). 31 Jan 1978. Contract AC03-77CS21693. 40p. NTIS, PC A03/MF A01. Order Number DE81026650.

An analysis of the NAHB Thermal Performance Guidelines for One and Two Family Dwellings is presented, relative to the following thermal performance guideline methodologies: thermal performance in existing homes (conventional); HUD Minimum Property Standards (MPS); American Society of Heating, Refrigerating, and Air Conditioning Engineers Standard 90-75 (ASHRAE 90-75); and Farmers Home Administration guidelines (FmHA). In addition to analyzing the NAHB guidelines in a comparative sense, the validity, usefulness, and potential acceptability of the methodology are also discussed. Among the specific factors considered comparatively and analytically are the following: level of thermal performance obtained as compared with existing standards; economic impact on builders/developers, and home-buyers of recommended performance guidelines; and technical accuracy, validity of assumptions, and reasonableness of procedures of the methodology.

28871 **(DOE/CS/30292—3) SOLPLAN report: an assessment of barriers and incentives to conservation and alternative-energy use in the residential sector in Wisconsin.** Fulenwider, C.K.; Weiss, L.S.; Pfefferkorn, C.; Wiener, D.E.; Feldman, S.L. (Wisconsin Center for Public Policy, Madison (USA)). Mar 1981. Contract FG02-79CS30292. 453p. NTIS, PC A20/MF A01.

The Alternative Energy Policy Project of the Wisconsin Center for Public Policy focused upon two principle objectives: (1) gathering and analyzing new and previously unavailable data on barriers and incentives to greater energy conservation and alternative energy commercialization in the state of Wisconsin; and (2) building consensus around alternative energy policy to develop guidelines for alternative energy policy for the state. Particular attention was paid to public involvement in the policy process and to assessing barriers and incentives from as many key sectors of the energy field as possible. Thus, data were gathered from the general public, alternative energy users, the heating industry generally, the alternative-energy industry specifically, and key decision makers. The report is divided into four principal sections. The first looks at findings and analyses dealing with barriers to greater conservation and alternative energy use. Incentives for accelerating the extent of residential conservation and alternative energy use are discussed in the second section. The decision-making process itself in energy policy has been little analyzed and seldom documented. The role of consensus-building in the alternative-energy field and analysis of the decision-making process are discussed in Section III. Appendices in Section IV provide survey instruments and descriptions, a compendium of energy-related legislation developed within the project, and various reports. The total report reflects the interactive decision-making model as it was applied in SOLPLAN. (MCW)

28872 **(DOE/CS/30584—1) Three prototype designs for an exterior-mounted, interior-operated, movable insulation system. Phase I. Final report.** Dike, G.; Florey, D.; Levy, A.; Sacks, S.; Kinney, L. (Syracuse Research Corp., NY (USA). Energy Research Center). Mar 1981. Contract FC02-80CS30584. 357p. NTIS, PC A16/MF A01. Order Number DE81025586.

Design, construction, and preliminary testing of three exterior-mounted, interior-operated, movable window insulation systems are described. Two of the systems are hinged insulated shutter systems and the third is a sliding shutter system. The advantages of such systems are discussed. Development, schematics, and oper-

ation of the prototype systems are described in Section 2. Section 3 provides an analysis of the thermal performance of the prototype shutters. A preliminary market assessment study was made and is reported in 8 sections: state tax incentives; the effects of the Residential Conservation Service Program; cost effectiveness of movable window insulation; analysis of the census of retail trade data; analysis of related reports and surveys; the low-income and movable window insulation; community development corporations and movable window insulation; and results from manufacturers survey. The prototype fabrication and test plan are presented in Section 5.0 and Section 6.0 includes estimated costs of the proposed designs. (MCW)

28873 **(DOE/EIA—0288/2and3) Nonresidential-building energy-consumption survey, 1979. Final report, Part II and Part III.** (Westat, Inc., Rockville, MD (USA)). Jun 1981. Contract AC01-78EI06389. 139p. NTIS, PC A07/MF A01. Order Number DE81027841.

The Utility Survey component of the Nonresidential Building Energy Consumption Survey was designed to provide data on the quantity and costs of energy consumed during 1979 by each building represented in the Building Survey data. To this end, 13,386 consumption and cost reporting forms were mailed to 1509 companies/organizations/agencies who supplied some type of energy to the 6222 buildings represented in the data from the earlier Building Survey. Part II, Section 2 discusses the step-by-step process of building the computer and manual files that were needed in order to conduct the Utility Survey. How the files were actually used in order to implement, control, and manage the Utility Survey was also discussed. Section 3 discusses the reporting forms and the accompanying instructional material used to collect data from the energy suppliers and Section 4 discusses the various operations for implementing the data collection task. The proessing of the data is described in Section 5 and the method of keeping the data confidential is described in Section 6. Part III, Section 7 presents several analyses of the costs associated with the Interim Nonresidential Building Energy Consumption Survey. Tables included reflect costs incurred through April 25, 1981. Administrative correspondence, record sheets, and explanatory notes are included in appendices. (MCW)

28874 **(DOE/IG—136) Weatherization program in Virginia.** (Department of Energy, Washington, DC (USA). Office of Inspector General). 24 Oct 1980. 66p. NTIS, PC A04/MF A01. Order Number DE81026027.

As authorized by the Energy Conservation and Production Act of 1976, DOE makes weatherization grants to states. These grants are intended to be used to insulate the homes of low-income persons to conserve energy. The grants are made according to such factors as climate and the number of eligible recipients. While the administration of a state weatherization program usually rests with the respective state government, the Commonwealth of Virginia has delegated the administration of its program to a private, nonprofit organization, the Virginia Association of Community Action Agencies, Inc. (the Association) in Richmond. A review of the program was conducted. The review of selected parts of the program indicates that a significant amount of the weatherization funds may have been wasted due to poor administration and that ineligble homeowners have had their home weatherized. The accounting procedures were inadequate, so that a complete accounting of the DOE weatherization grants to Virginia is impossible. An examination was made of financial and inventory reports, 32 weatherized homes were inspected, internal controls and management information systems were reviewed, and discussions were conducted. The review included operation of the program from November 1977 through January 1980. (MCW)

28875 **(DOE/SF/01178—T10) California residential energy regulations: their impact on the building process.** (California State Dept. of Housing and Community Development, Sacramento (USA)). Feb 1977. Contract AC03-76SF01178. 114p. NTIS, PC A06/MF A01. Order Number DE81026708.

A study of various building sectors impacted by statewide energy regulations has been conducted. More than eighty interviews were conducted with local building code enforcement officers, achitects and engineers, builders and developers, building material suppliers and manufacturers, and homeowners. The various groups identified problems encountered with energy regulations and their response. The report contains recommendations for action by all levels of government and the building sector. Recommendations are directed towards current administrative practices; the technical aspects of the regulations, including product approval and certification, and educational needs.

28876 **(DOE/SF/11505—T3) High-efficiency vapor-compression dehumidifier. Technical status report, May 1-May 31, 1981.** (Trinity Univ., San Antonio, TX (USA)). 1981. Contract FC03-80SF11505. 19p. NTIS, PC A02/MF A01. Order Number DE81027513.

Progress is reported on the high-efficiency vapor-compression dehumidifier research. Market assessment studies have been completed that establish the need for a dehumidification system to support passive cooling. Two papers are included: Supplemental Cooling Requirements of Passively Cooled Buildings in Selected American Cities and Sensible and Latent Cooling Requirements of Conventional and Passively Cooled Residences in American Climates. Dehumidification experiments resulted in the development of a curve relating COP to air flow rate. The curve is presented. A proposal for engineering field testing of a sensible cooling recovery process dehumidifier was completed. (MCW)

28877 **(IS-M—333) Transient analysis of heat loss in earth bermed structures.** Szydlowski, R.F.; Kuehn, T.H. (Ames Lab., IA (USA); Iowa State Univ. of Science and Technology, Ames (USA). Engineering Research Inst.). 1980. Contract W-7405-ENG-82. 3p. (CONF-801016—26). NTIS, PC A02/MF A01. Order Number DE81025449.

From 5. national passive solar conference; Amherst, MA, USA (19 Oct 1980).

Passive solar structures commonly utilize earth bermed walls to enhance energy conservation in spite of the lack of well-validated guidelines capable of quantifying their expected thermal performance. In an effort to provide some added insight on the thermal response of earth bermed structures, a transient two-dimensional model sufficiently general to accommodate numerous earth sheltering configurations under variable boundary and soil conditions has been developed. This allows accelerated investigation of systems which, due to their thermal properties, are transient in nature with extremely long time constants. The present model considers time dependent soil properties, different types of below-grade structure configurations, and various types, thicknesses and locations of insulation. Heat loss and gain through the exterior building envelope versus location and time of year are given as functions of construction materials, insulation and soil geometry.

28878 **(IS-M—351) KLEGECELL: a new lightweight insulating material with superior properties.** Hodges, L. (Ames Lab., IA (USA)). 1980. Contract W-7405-ENG-82. 3p. (CONF-801016—24). NTIS, PC A02/MF A01. Order Number DE81025529.

From 5. national passive solar conference; Amherst, MA, USA (19 Oct 1980).

Klegecell -- the brand name of a rigid polyvinyl chloride foam used extensively in the marine and aviation industries -- has substantial advantages over other rigid insulation for certain passive solar applications, particularly as movable insulation. It comes in lightweight rigid panels with high insulating values (R = 7 per inch) so that thin panels are adequate. Its low water vapor permeability makes it suitable for use on the inside of glazing in cold climates, since it prevents condensation from occurring. Its nonflammability is a particularly desirable property for interior use.

28879 **(IS-T—932) Analysis of transient heat loss in earth-sheltered structures.** Szydlowski, R.F. (Ames Lab., IA (USA)). Sep 1980. Contract W-7405-ENG-82. 213p. NTIS, PC A10/MF A01. Order Number DE81027292.

Thesis. Submitted to Iowa State Univ., Ames.

The two-dimensional transient Fourier heat conduction equation has been solved in cartesian coordinates using an alternating direction implicit finite difference technique for several earth sheltered building configurations. The model has been computer coded

and verified by comparing results with data taken from an instrumented conventional residence basement. The present model considers variable soil properties, different types of below grade configurations, and various types, thicknesses, and locations of insulation. The model has been used to analyze the thermal impact of varying levels of interior and exterior insulation on conventional basements, earth bermed walls, and earth covered structures. Local and integrated heat transfer through the exterior building envelope versus time of year are given as functions of construction materials, insulation, and soil geometry. Temperature distributions within the building envelope material and in the surrounding soil are presented versus time of year. An economic analysis is also given to indicate the cost effectiveness of the insulation levels analyzed.

28880 **(LA—8886-MS) Weighting factors in the DOE-2 computer program.** Kerrisk, J.F. (Los Alamos National Lab., NM (USA)). Jun 1981. Contract W-7405-ENG-36. 85p. NTIS, PC A05/MF A01. Order Number DE81028593.

The DOE-2 computer program uses weighting factors for the calculation of thermal loads and air temperatures in buildings. The weighting factors, which represent parameters in z-transfer functions, can be selected from data for typical rooms (precalculated weighting factors) or can be calculated for rooms in the particular building under consideration (custom weighting factors). This report describes the method used to calculate custom weighting factors in DOE-2.1. A preliminary discussion of z-transforms and transfer-function solutions to differential equations is followed by a detailed description of how the transfer functions and weighting factors for a room are obtained. Models employed in the calculation of various types of weighting factors are outlined. During these discussions, significant assumptions inherent in the use of weighting factors are identified. Relations between weighting factors and some room properties, such as conductance and heat capacity, are also developed.

28881 **(LBL—11703) International comparison of residential energy use: indicators of residential energy use and efficiency. Part one: the data base.** Schipper, L.; Ketoff, A.; Meyers, S. (Lawrence Berkeley Lab., CA (USA)). May 1981. Contract W-7405-ENG-48. 129p. NTIS, PC A07/MF A01. Order Number DE81028550.

This summary report presents information on the end-uses of energy in the residential sector of seven major OECD countries over the period 1960-1978. Data are presented on energy consumption by energy type and end-use for three to five different years for each country. Each year table is complemented by a set of indicators, which are assembled for the entire 20-year period at the end of each country listing. Finally, a set of key indicators from each country is displayed together in a table, allowing comparison for three periods: early (1960-63), pre-embargo (1970-73), and recent (1975-78). Analysis of these results, smoothing and interpolation of the data, addition of further data, and analytical comparison of in-country, and cross-country trends will follow in the next phase of the work.

28882 **(LBL—11828) Indoor air quality and energy-efficiency ventilation rates at a New York City elementary school.** Young, R.A.; Berk, J.V.; Hollowell, C.D.; Pepper, J.H.; Turiel, I. (Lawrence Berkeley Lab., CA (USA)). May 1981. Contract W-7405-ENG-48. 67p. NTIS, PC A04/MF A01. Order Number DE81028548.

An assessment was made of the indoor air quality at Oakland Gardens Elementary School in New York City under three different ventilation rates. A mobile laboratory was used to monitor air quality in two classrooms, a hallway, and outdoors. The parameters measured were air exchange rates, particulates, odor perception, carbon dioxide, carbon monoxide, sulfur dioxide, ozone, nitrogen oxides, radon, formaldehyde and total aldehydes. When the ventilation rate was reduced, carbon dioxide concentrations increased significantly, but did not exceed current occupational standards. At the low ventilation rate, odor acceptability decreased and in one of the classrooms the odors were judged unacceptable according to current ASHRAE standards. Calculations indicate that moderate energy savings can be achieved by reducing the ventilation rate in the classrooms.

28883 **(LBL—12119) High-performance solar-control windows. Final report.** King, W.J. (Lawrence Berkeley Lab., CA (USA); Kinetic Coatings, Inc., Burlington, MA (USA)). Apr 1980. Contract W-7405-ENG-48. 189p. NTIS, PC A09/MF A01. Order Number DE81028906.

The use of ion-beam sputtered, metal-dielectric layers was investigated for fabricating high-performance solar-control windows for office buildings and residences. Two basic types of windows were studied. The first was optimized for rejecting incident solar energy during the cooling season while maintaining high daylight transmittance. The second was optimized for transmission of solar energy and reduction of thermal losses in the heating season by maximizing reflectivity in the long-wave infrared (i.e., transparent heat mirror). Various compromise configurations for performing both functions were also considered. The program covered original equipment (glass) and retrofit (plastic) substrate materials. Various metal-dielectric combinations, including Cu-SiO_2, Bs-SiO_2 (Bs = brass), Bs-Al_2O_3, AG-SiO_2, and Ag-Al_2O_3, were used to obtain the necessary optical characteristics. Extensive weathering tests were conducted to demonstrate that the final systems developed are capable of extended life in a practical environment. Roll-to-roll (1' wide) coating was demonstrated for retrofit office and residential windows on various forms of polyester. Comparable window performance was achieved on polypropylene and teflon FEP substrates. A brief economic analysis is presented which indicates that KCl's processing is completely consistent with the price structure in the solar-control film industry.

28884 **(NP—1903404) Materials thermal test facility for energy conservation. Final report, January 1, 1980-September 30, 1980.** Edgel, W.R. (New Mexico Univ., Albuquerque (USA). Engineering Research Inst.). May 1981. 66p. (EMD—2-68-1109). New Mexico Energy and Minerals Department, Santa Fe. Order Number DE81903404.

The development of a guarded hot box thermal test facility is described. The facility, developed primarily with New Mexico State Energy and Minerals Department funds and operated primarily with industrial funding, is presently capable of supporting a steady state U-value test per ASTM C 236-66 and of supporting step function dynamic tests (for which no standard yet exists). The need for full dynamic testing is discussed, along with recommendations as to how to extend the existing facility to support it.

28885 **(ORNL/CON—74) Housing market capitalization of energy-saving durable good investments.** Johnson, R.C. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 120p. NTIS, PC A06/MF A01. Order Number DE81027543.

Rising energy prices provide an economic incentive to substitute capital for fuel in production processes, where the extent of substitution that is feasible is constrained by existing technologies. In the residential sector, such capital-fuel substitution depends upon the willingness of builders and homeowners to invest in the durable goods that make the house energy conserving. Since these durable goods become permanently attached to the dwelling unit and since ownership is likely to change over the lifetime of the house, the incentive to carry out an investment in energy conservation depends critically upon the efficiency of the housing market in capitalizing the financial benefits of future fuel savings. In this study of the Knoxville housing market during 1978, an hedonic price equation of the form $P = f(U, X)$ was estimated, where P is the sale price of the house, U is the annual utility (fuel) bill, and X is a vector of structural, locational, and neighborhood attributes. The estimated hedonic price index reveals that, holding other influences constant, the marginal effect of a one-dollar savings in the annual fuel bill is to increase the sale price of the house by approximately $21. Estimates of implicit market discount rates, under various assumptions about fuel escalation rates and remaining lifetimes of the houses, indicate that the housing market performed in a manner consistent with a social discount rate of about 10 percent. The results of the study do not show whether or not investment in energy conservation is proceeding at a socially optimum rate, only that the housing market, in this location and period of time, did operate efficiently in capitalizing the investments.

28886 **(ORNL/CON—77) Analysis of energy audits at 48 hospitals.** Hirst, E.; Stelson, J.; Carney, J.; Goeltz, R. (Oak Ridge National Lab., TN (USA); Oak Ridge Associated Universities, Inc., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 41p. NTIS, PC A03/MF A01. Order Number DE81027678.

Energy audits at 48 hospitals in four states (New York, Pennsylvania, Virginia, Tennessee) between 1978 and 1980 were conducted. A computerized data base containing information from these audits was developed and organized. This report describes the audit process; summarizes the data collected from these audits on hospital characteristics, annual energy use, and the audit recommendations; and analyzes the audit data in terms of cost-effectiveness, type of recommendations, and the relationship between potential energy saving and characteristics of the individual hospital. Floorspace averages 197,000 ft^2 (18,300 m^2) and annual energy use averages 480 kBtu/ft^2 (5.4 GJ/m^2) at these 48 hospitals. However, there is considerable variation among hospitals; for example the ratio of maximum to minimum energy use is 3.5 and the coefficient of variation (ratio of the standard deviation to the mean) is 25%. The energy audits show an average potential energy saving of almost 100 kBtu/ft^2 (1.1 GJ/m^2), equivalent to a reduction in annual energy use of 20%. The variation among hospitals is large; the range is from 6 to 49% of baseline energy use. The cost to implement all these conservation practices and measures is quite low, about 25 cents/ft^2 ($2.65/$m^2$), wich implies an average payback period of only one year. Analysis of the audit results shows that the potential energy saving at a hospital inceases with baseline energy use and decreases with fuel price. This suggests that large potential energy savings will be found at hospitals that are particularly energy-intensive and that have low fuel prices.

28887 **(ORNL/Sub—80/61602/1) Assessment of building diagnostics.** Courville, G.E. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 118p. NTIS, PC A06/MF A01. Order Number DE81027078.

This Assessment addresses the building-diagnostics requirements for in-situ or field measurements on energy consumption in conditioned spaces and on heat gain and loss in residential and nonresidential buildings. The demand for better building-performance data and its application to energy management and retrofit decisions require more accurate on-site data with emphasis on dynamic performance. A successful diagnostics program must emphasize equally the development of new instruments or the adaptation of existing instruments, the development of appropriate consensus measurement standards, and the development of the training techniques needed for optimum use of these instruments. This Assessment addresses four trend areas within the building sciences which can have a significant impact on energy conservation: (1) Energy Audit Programs, (2) Energy Performance Monitoring, (3) Energy Flow in Buildings, and (4) Use of Computer Technology. It is concluded that a correctly chosen building-diagnostics program can positively contribute to and, in fact, accelerate the implementation of energy-conservation measures within these trend areas. The diagnostics program outlined in this Assessment is developed from a set of program action areas that encompass the broad diagnostics needs identified within the trends. This diagnostics program plan contains specific project suggestions within the following program elements: Envelope Thermal Performance Evaluation Techniques; Efficiency and COP of HVAC Systems; Large Scale No-Visit Surveys; Whole Building Periodic Audits; Electronics Technology Transfer; Energy Performance Monitoring in Buildings; Interior Environmental Monitoring; Research and Development; and Information Dissemination. These nine program elements thus form the foundation of a diagnostics program that will address the major diagnostic issues that are currently limiting the timely achievement of our national energy-conservation goals.

28888 **(ORNL/TM—7640) Assessment of roofing research.** Robinson, J.N. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 59p. NTIS, PC A04/MF A01. Order Number DE81027077.

Problems related to roofing are assessed within the context of energy conservation. Appropriate actions for existing roofs, new roofs, and future roofs are ordered into a thermally efficient roofing plan, and priorities for its implementation are proposed. Sections of this report consider background information relating to roofing (II), the methodology used in performing the assessment (III), an overview of issues encountered during the assessment (IV), summaries of the problem statements that have been assessed to date (V), recommendations of needed work (VI), and the thermally efficient roofing plan that is recommended for implementation (VII). (MCW)

28889 **(PNL—3883) Sampling design for the 1980 commercial and multifamily residential building survey.** Bowen, W.M.; Olsen, A.R.; Nieves, A.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1981. Contract AC06-76RL01830. 98p. NTIS, PC A05/MF A01. Order Number DE81028783.

Details of a proposed sample design for the 1980 Commercial and Multifamily Building Energy Performance Survey are presented. The objective of the survey is to assess the extent to which new building design practices comply with the proposed 1980 Energy Budget Levels for Commercial and Multifamily Residential Building Designs (DEB_{80}). The procedure will be to: identify a small number of building types which account for the majority of commercial buildings constructed in the U.S.A.; conduct a separate survey for each building type; and include only buildings designed during 1980. For each building in the survey, the Design Energy Consumption (DEC_{80}) will be determined by the DOE2.1 computer program. The quantity $X = (DEC_{80} - DEB_{80})$, will be calculated for each building as a measure of its compliance with DEB_{80}. These X quantities will then be used to compute sample statistics. Inferences about nationwide compliance with DEB_{80} may then be made for each building type. This report provides details of the population, sampling frame, stratification, sample size, and implementation of the sampling plan.

28890 **(SAI—026-79-812-LJ) Consumer products minimum energy-efficiency standards program. Topical report: Subtask 3.1, minimum energy efficiency standards for clothes dryers.** (Science Applications, Inc., La Jolla, CA (USA)). 1 Aug 1979. Contract AC03-79CS10757. 141p. NTIS, PC A07/MF A01.

The purpose of this study is to asses the desirability of implementing minimum energy efficiency standards for clothes dryers, according to the NECPA requirements, based on the cost effectiveness of the technologically feasible design improvements. Section 2 contains consumer use patterns, typical energy consumption of clothes dryers in the United States, and a discussion of the candidate technical design improvements. The selected design changes and their impact on energy savings, the increased capital cost to the consumer, and the corresponding decreased cost in operation of dryers are discussed in Section 3. The increased cost for compliance by a manufacturer for testing and labeling, according to the NECPA requirements, per unit dryer manufactured, is estimated in Section 4. Section 5 presents the cost benefit analysis for implementing energy efficiency improvement design changes and the minimum efficiency standards. The desirability of implementing minimum energy efficiency is discussed in Section 6, followed by the conclusions and recommendations of the study, which appear in Section 7.

28891 **(SAI—026-79-923-LJ) Regional versus national standards for room air conditioners, central air conditioners, heat pumps and furnaces. Topical report subtask 3.3.** (Science Applications, Inc., La Jolla, CA (USA)). 26 Oct 1979. Contract AC03-79CS10757. 86p. NTIS, PC A05/MF A01.

The advantages and disadvantages of setting regional or national energy efficiency standards for space conditioning equipment are discussed. Section 1.0 presents economic, distribution, manufacturing, and enforcement issues. The preponderence of facts indicate that regional standards will result in a significant burden on manufacturers in testing requirements, reduced economics of scale, and disruption of their distribution system. Enforcement will be a significant problem due to the additional personnel and procedures required to monitor the increased testing and the difficulty in preventing products from crossing regional boundaries. Section 2.0 deals with consumer life cycle cost calculations. Regional energy efficiency standards, based on minimizing consumer life cycle cost in each region, are compared to the life cycle cost decrement, first

cost decrement, and national energy consumption resulting from setting national energy efficiency standards. Appendices A through E present the life cycle cost calculations, including the first cost and present worth of the operating costs. Life cycle costs are presented as a function of energy efficiency for each region. Appendix F presents energy consumption calculation procedures for each product. Appendix G explains the calculations used to generate the population of each product by region as used in national energy consumption calculations.

28892 **(SERI/TR—98252-1b) User needs for solar decision-making tools: the homebuilding industry. Final report.** Kantrowitz, M.; Kurtz, J.; Hart, K. (Solar Energy Research Inst., Golden, CO (USA); Booz-Allen and Hamilton, Inc., Bethesda, MD (USA). Energy and Environment Div.). Jun 1981. Contract AC02-77CH00178. 131p. NTIS, PC A07/MF A01. Order Number DE81027293.

A study of the need for decision tools and design tools to be used by decision makers considering using solar energy in the single-family residential construction sector is presented. The study finds three builder groups based upon decision making patterns relative to innovation and a five-step decision process. The report also reviews eleven existing design tools against identified user needs. The principal conclusions are that decision tools are largely lacking and design tools do not easily fit user needs. Recommendations for further study are made.

28893 **Programmable controller saves office lighting energy.** Knisley, J.R. *Electrical Construction and Maintenance ;* **79**: No. 11, 74-77, 173(Nov 1980).

The function and performance of a programmable controller that holds in memory a series of on-off instructions to lighting circuits throughout the Ada County Administration Building in Boise, Idaho are described. Supplemental control by manually operated, momentary-contact switches connected to terminal strips on the transceiver chassis; photocontrols; and pushbutton-type telephones is explained. Setting of the automatic control is also explained. Flexibility of the wiring system is described. (MCW)

28894 **Daylighting saves energy.** *Electrical Construction and Maintenance ;* **79**: No. 11, 78-79(Nov 1980).

The use of daylighting in a seven-building office complex in Houston is described. Development of the scheme is briefly reviewed. Electric power consumption for lighting was reduced to an estimated 0.87 watt/ft^2, based on a conservative projection of annual use. (MCW)

28895 **Setback thermostat saves heating energy.** Brown, H.L.; Hamel, B.B. (Drexel Univ., Philadelphia, PA). *Electrical Construction and Maintenance ;* **79**: No. 9, 87-88, 158(Sep 1980).

A study designed to provide factual data to determine the effects of light-actuated 10°F setback thermostats on energy used in 5-room and 7-room homes is described. Input to the computer heating simulation model included monthly outdoor temperatures, people occupancy, applied usage, and other heat gains. The program then calculated the annual heating energy requirements, assuming that all thermostats would be set at a constant 72°F. This was repeated in Houston, Atlanta, Philadelphia, Chicago, Buffalo, and Bismarck. Then the same model was used with the thermostat set back to 62°F following a specific pattern each day. Definite savings were indicated and tabulated data list specific savings for the degree days of the 6 cities. Findings and test conditions are summarized. (MCW)

3202 Transportation

REFER ALSO TO CITATION(S) 28781, 28921, 29140

28896 **(DOE/CS/40004—T5) Potential energy savings in the light-vehicle, long-haul-truck, and bus market sectors.** (TRW, Inc., McLean, VA (USA). Energy Systems Planning Div.). 14 Nov 1977. Contract AC03-77CS40004. 27p. NTIS, PC A03/MF A01.

The potential oil and gas savings that could be realized in the transportation sector are calculated for the years 1980, 1985, and 2000. To date, two market sectors have been analyzed; light vehicles (automobiles, light trucks, and vans) and large vehicles (long haul trucks and buses). These analyses are described. Potential savings are identified at the physical system and operational option level and then aggregated by generic approach. The potential generic approach savings are further aggregated by market sectors. The physical systems and operational options investigated are shown in the transportation sector tree.

28897 **(DOE/CS/51175—T15) Energy use in the Marine Transportation Industry. Task II. Regulations and tariffs.** (Booz, Allen and Hamilton, Inc., Bethesda, MD (USA). Transportation Consulting Div.). 30 Jun 1977. Contract AC03-76CS51175. 113p. NTIS, PC A06/MF A01.

The regulatory framework of the commercial marine transportation industry is defined and these regulations are evaluated in terms of their energy impact. The approach used in the evaluation of the energy impacts of regulations and tariffs was structured around three sequential steps: identification of agencies and organizations that impact the commercial marine transportation industry; identification of existing or proposed regulations that were perceived to have a significant energy impact; and quantification of the energy impacts. Each of these three steps is described in detail. The report is organized around nine chapters. Chapter I contains an introduction and summary of the results and conclusions. Chapter II describes the regulatory structure of the commercial marine transportation industry and includes: a description of the role of each organization and the legislative basis for their jurisdiction; and an identification of major areas of regulation and those areas that have an energy impact. Chapters III through IX each address one of the seven existing or proposed regulatory or legislative actions that have an energy impact. The results of each of these seven case studies are summarized. (MCW)

28898 **(DOE/CS/52184—T13) Technical analysis support for the Office of Transportation Programs of DOE. Twenty-second progress report for May 1980.** (Aerospace Corp., El Segundo, CA (USA). Eastern Technical Div.). 10 Jun 1980. Contract AC03-78CS52184. 70p. NTIS, PC A04/MF A01. Order Number DE81027037.

The status of progress achieved and the expenditure status of five areas within the DOE Office of Transportation programs are briefly summarized. The areas include: heat engine and vehicles systems; alternative fuels utilization; nonhighway transport systems; new concepts evaluation; and electric and hybrid vehicle research programs. Summary data are tabulated of Job Orders selected and assigned to current and prospective support needs. An historical description of the work efforts assigned during this contract for the selected programs is presented in Appendix A. (MCW)

28899 **(DOE/SF/02006—T1) Long-tail shaft drive for energy-efficient boats. Final report.** Hastrup, H. (Hastrup (Herman), Kaneohe, HI (USA)). Feb 1981. Contract FG03-78SF02006. 25p. NTIS, PC A02/MF A01. Order Number DE81027809.

A long-tail shaft drive utilized in a propulsion system for small boats is described. The objectives of the grant are discussed. The performance of the long-tail shaft indicates a savings of approximately 50% of the fuel used by the conventional outboard motor with comparable horsepower. A summary of actions taken in regard to the reversible pitch propeller, propeller shrouds, and the tail shaft are presented. Eight test procedures are briefly outlined. Information on materials and manufacturing was sought and applied to the experimental work. Patent, manufacturing, and marketing considerations are noted. Conclusions and recommendations are summarized. (MCW)

28900 **(NP—1903572) Gasohol fleet-testing project: Land Between The Lakes.** (Tennessee Valley Authority, Chattanooga (USA). Div. of Property and Services). May 1980. 22p. NTIS, PC A02/MF A01. Order Number DE81903572.

Fleet testing of gasohol, a blend of 10% ethyl alcohol and 90% unleaded gasoline, was performed at the Land Between The Lakes recreation area in western Tennessee and Kentucky. During the year-long test (March 1979 to March 1980), approximately two million miles were logged by the fleet of 176 vehicles. Analysis of

the test data resulted in the following significant findings: decrease in overall fleet mileage rating of approximately 3% with gasohol which was statistically significant at the 95% level of confidence; fuel savings of approximately 17,000 gallons of gasoline at an additional cost of roughly $17,000 yearly; increase in fuel-related maintenance after fleet conversion to gasohol, specifically for carburetor components; and no substantial changes in vehicle performance on gasohol with the exception of the occurrence of more driveability problems relating to engine starts in cold weather and vehicle hesitation, bucking, or coughing. The fleet was composed of cars, vans, trucks, etc.

28901 **(ORNL—5728) Aggregate demand for gasoline and highway passenger vehicles in the United States: a review of the literature 1938-1978.** Greene, D.L. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 166p. NTIS, PC A08/MF A01. Order Number DE81027207.

This paper reviews previous analyses of the demand for automobiles and gasoline in the United States. First, studies of automobiles and gasoline demand are reviewed individually. The historical literature divides fairly cleanly into separate considerations of the two commodities. More recently, increased interest in influencing the demand for petroleum through various government policies has generated a broader interest in the factors influencing the demand for highway motor fuel and spawned models that simultaneously consider the demand for travel, the demand for gasoline, and the size and characteristics of the automobile stock. These more recent studies are reviewed last. The section concludes with summary observations on the state of knowledge of motor vehicle and gasoline demand forecasting as it relates to modeling gasoline demand at subnational levels.

28902 **(P—300-81-003) Independent-staff transportation-fuels-demand forecast, 1980-2000. Staff report.** (California Energy Resources Conservation and Development Commission, Sacramento (USA)). Feb 1981. 77p. California Energy Resources Conservation and Development Commission, Sacramento. Order Number DE81903662.

The methodology employed by staff in the development of a California transportation fuels demand forecast, the historical projected data used by the model (including, but not limited to, gasoline and diesel automobile and truck sales, miles per gallon (MPG), and vehicles miles traveled, diesel vehicle market penetration; electric vehicle forecast), and the forecasted demands for gasoline, diesel, jet fuel, residual and liquefied petroleum gas are presented. The demands for gasoline and diesel are disaggregated by mode (i.e., auto, truck, and other), and a conservation scenario is also reported.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 28039, 28090, 28130, 28589, 29130, 29157

28903 **(DOE/CS/40005—T1) High-temperature industrial heat pump. Management plan.** Deckman, G. (AiResearch Mfg. Co., Torrance, CA (USA)). 12 Mar 1979. Contract AC03-78CS40005. 62p. NTIS, PC A04/MF A01.

The management plan for the development and demonstration of a high-temperature industrial heat pump for milk drying is presented. Section 2 describes the overall objective, technical approach, and program scope for development and demonstration of a heat pump system for use in an existing milk drying operation. The high temperature industrial heat pump program organization, its relationships to higher-level AiResearch organizations, subcontractor relationships, and personnel responsibilities are discussed in Section 3. The program management and control functions and data management techniques are described in Section 4. The activity for each work breakdown structure is described in Section 5. The program schedule is schematically shown in Section 6 and cost management reports are described in Section 7.

28904 **(DOE/CS/40086—T1) Preliming of sugar beet cossettes to reduce energy in sugar beet processing. Final technical report, August 1, 1978-January 31, 1981.** Randall, J.M. (Department of Agriculture, Albany, CA (USA). Western Regional Research Center). 30 Jun 1981. Contract AI01-78CS40086. 56p. NTIS, PC A04/MF A01. Order Number DE81026001.

In the United States, the beet sugar industry is the most intensive user of energy, per unit value of product shipped. Approximately 2.6 x 10^6 Btu of energy are required per ton of beets processed. The increasing cost and scarcity of energy has made the industry very receptive to process changes which can reduce energy requirements for sugar production. A two-year project was undertaken to determine the feasibility of liming fresh sugar beet cossettes, prior to extraction, as a means of reducing energy consumption. Fresh $Ca(OH)_2$ was added to cossettes for 10 min prior to introduction into the diffuser (extractor). It was found that up to 3.5 x 10^5 Btu/ton of beets sliced could be saved in pulp drying and 0.45 x 10^5 Btu/ton could be saved in production of lime (13.5% and 1.7%, respectively, of current overall energy requirements of the beet-sugar process). Quality of raw juice from the diffuser was much better with limed cossettes than with control cossettes. Experimental thin juice was slightly higher in lime salts and lower in quality than controls. Liming of cossettes by dipping in a slurry of 2.6% $Ca(OH)_2$ gave better results than mixing of cossettes with dry $Ca(OH)_2$ and would be much easier to implement in an existing plant.

28905 **(DOE/CS/40150—T1) High consistency forming process for papermaking. Phase II. Final report.** Kranz, W.T.; Judd, M.; Rotherham, J. (Thermo Electron Engineering Corp., Waltham, MA (USA); Thermo Electron Corp., Auburn, MA (USA). Lodding Div.). Sep 1980. Contract AC02-78CS40150. 98p. NTIS, PC A05/MF A01. Order Number DE81026511.

The demonstration program for saving energy that can be obtained by forming paper and paperboard products at initial high fiber concentration is discussed. Under Phase II, a limited number of design modifications were made to the low speed high consistency headbox. These resulted in improved sheet formation for samples used in subsequent press studies. Comparisons of sheet physical and drainage properties were made between low and high consistency sheets. Equipment for these tests was designed and fabricated during Phase II, including a laboratory scale dynamic roll nip press with single felt. The high consistency sheet had significantly higher permeability and compressive modulus than the low consistency sheet. In simulated three nip press studies the high consistency sheet demonstrated a 1.5 to 2.5% higher solids content than the low consistency sheet under the same operating parameters. The effect of variables such as machine speed, sheet basis weight, nip loading and entering sheet consistency were investigated. Rules for scaling between laboratory and full size press nips have been established. The energy saving potential for the paper industry through the use of high consistency forming was estimated as 6 to 7% of current total consumption.

28906 **(DOE/CS/40361—T4) Hierarchy control for energy savings in the steel industry. Annual report, July 1, 1980-June 30, 1981.** (Purdue Univ., Lafayette, IN (USA). Purdue Lab. for Applied Industrial Control). 1981. Contract AS07-80CS40361. 272p. NTIS, PC A12/MF A01. Order Number DE81027861.

The report presents details of work completed during the past year, that in progress, and that planned for the immediate future under each of five tasks by each research team. It also details the working contacts maintained with the steel industry, particularly with those companies who sponsor the project. Chapter I presents background information and explains the present DOE project. The next three chapters present individual reports by researchers. These are: Task I, Process Mathematical Models; Task II, Integrated Production Planning and Control; Task III, Functional Requirements for a Hierarchical Computer Control System; and Task IV, Man-Machine Interfaces. Chapter V includes reports on workshops, meetings, etc. Particular progress was noted in the dynamic model of the blast furnace, in the scheduling study in batch annealing, and in the man-machine interface areas. (MCW)

28907 **(DOE/CS/40361—T5) Production scheduling of annealing furnaces. Report No. 119.** Gau, C.F.; Moodie, C.L. (Purdue Research Foundation, Lafayette, IN (USA); Purdue Univ., Lafayette, IN (USA). Purdue Lab. for Applied Industrial Control). Apr 1981. Contract AS07-80CS40361. 66p. NTIS, PC A04/MF A01. Order Number DE81027802.

The annealing of steel coils, where the object of the process is to remove the effects of previous cold working, is described. The procedure is described and involves stacking one coil on the other. To obtain a greater loading and thereby an increased annealing rate per furnace, a general computer procedure was established to provide the criteria for the optimal loading problem in terms of the stack height utilization and the energy efficiency of the annealing furnaces. The problem and the computerized procedure are described in detail. Results of computer runs made for specific examples are discussed. Conclusions are summarized. (MCW)

28908 **(DOE/ET/12005—T1) Salvaged waste water from California: its use in western electrical power generation, agriculture, and other regional resource developments.** Jeppson, M.R. (Jeppson (Morris R.), Carmel, CA (USA)). Feb 1979. Contract FG03-77ET12005. 117p. (SAN—1607-1). NTIS, PC A06/MF A01. Order Number DE81024303.

The availability of a new source of water reserved for use in the production of electrical energy for California is described. The first four chapters are intended to show that the proposed regional waste water reclamation and power production projects are economically reasonable and involve existing technology. The second section includes discussions of concepts for the use of part of the supply of reclaimed water to enable the development of alternative energy resources, geothermal, and solar, in the desert regions through which the proposed water project pipelines would pass. New technology will be needed to realize the benefits described in Chapters 5 through 8.

28909 **(DOE/ET/12866—8-Vol.2) Residual-energy-applications program: EAST-facility requirements document.** Yngve, P.W.; Zander, F.H. (South Carolina Energy Research Inst., Columbia (USA)). 31 Jul 1981. Contract AC09-77ET12866. 237p. NTIS, PC A11/MF A01. Order Number DE81027489.

An Energy Applied Systems Test (EAST) Facility will be constructed at the Savannah River Plant to serve as the primary systems test and evaluation facility for the Department of Energy's Residual Energy Applications Program (REAP). The REAP goal is to stimulate the private sector to use available residual heat currently being dissipated. The objectives of the EAST Facility are to perform research and development on heat energy recovery and conversion equipment; establish high confidence in system performance, system availability, and system operating, maintenance, and material costs; and provide a national competence in technologies required for the installation and operation of heat recovery systems. The purpose of this document is to provide design specifications for the EAST Facility. Volume I presents an initial testing capability recommended for EAST and design specifications are provided for the physical plant and major test support systems. Volume II contains detailed descriptions of seven potential test articles which represent a wide range of types and sizes of heat recovery systems. This volume discusses EAST operations, including test planning, test policies, systems testing, and facility organization and staffing. Additionally, information is included on a preliminary site analysis for the EAST Facility and other test support system requirements are described.

28910 **(DOE/ET/12866—9) South Carolina applications for industrial waste-heat recovery using heat pumps and Rankine-cycle power-generation systems.** (South Carolina Energy Research Inst., Columbia (USA)). Jul 1981. Contract AC09-77ET12866. 77p. NTIS, PC A05/MF A01. Order Number DE81027537.

Applications for Rankine cycle power generation systems and heat pumps were examined for six South Carolina industries: textile finishing, pulp and paper, noncellulosic fibers, pressed and blown glass, hydraulic cement, and secondary nonferrous metals. Thermodynamic and economic calculations determined system outputs and after-tax rates of return. The number of applications and net system outputs for the United States and for South Carolina were estimated.

28911 **(DOE/TIC—1023619) Federal role in industrial energy conservation.** (Department of Energy, Washington, DC (USA)). 16 Apr 1979. 44p. NTIS, PC A03/MF A01. Order Number DE81023619.

A review of the major US policy options in industrial energy conservation is presented. In examining these policies on their own merit and against the backdrop of other US energy options, the case is made for a strong federal role in industrial energy conservation. The need for a federal role is examined. Principles set forth to provide a framework for evaluating the degree to which present and future policies work together toward the goals of industrial energy conservation are discussed. Policy options which the federal government could consider for implementing energy conservation and fuel switching in the industrial sector fall into three general categories: punitive, incentive, and complementary options. The punitive policies considered in this analysis include: minimum performance standards for selected equipment; mandatory energy productivity targets; energy taxes; and mandatory fuel switching for selected equipment. Other punitive policies might have included product bans, procurement sanctions, etc., but these were considered too discriminatory to be practical. Incentive policies considered in this analysis include: cost-sharing in the development of conservation technology; financial incentives for installing specific technologies; relaxation of existing policy inhibiting conservation. Complementary policies considered include: voluntary energy productivity targets and energy reporting and technology transfer, technical assistance, and promotional efforts. Detailed discussion of these options is provided in Appendix A. The innovative process in industry and the Industrial Technological Trust Fund are discussed in additional appendices. (MCW)

28912 **(DOT-HS—803-768) How to save truck fuel.** (Department of Transportation, Washington, DC (USA); Department of Energy, Washington, DC (USA); Environmental Protection Agency, Washington, DC (USA)). Jan 1980. 69p. NTIS, PC A04/MF A01. Order Number DE81028182.

The future of fuel costs and its availability is discussed. Six areas of potential fuel savings for trucks discussed are: aerodynamic drag, rolling resistance, power train efficiency and speed control, vehicle maintenance, driving practices, and operational techniques. (MCW)

28913 **(EPRI-EA—1956-Vol.2) Models for forecasting energy use in the US farm sector. Volume 2. Final report.** Christensen, L.R. (Christensen (Laurits R.) Associates, Inc., Madison, WI (USA)). Jul 1981. 131p. NTIS, PC A07/MF A01.

Econometric models are developed and estimated for the purpose of forecasting electricity and petroleum demand in US agriculture. A structural approach is pursued which takes account of the fact that the quantity demanded of any one input is a decision made in conjunction with other input decisions. Seven different functional forms of varying degrees of complexity are specified for the structural cost function, which describes the cost of production as a function of the level of output and factor prices. Demand for materials (all purchased inputs) are derived from these models. A separate model breaks this demand up into demand for the four components of materials. This model is used to produce forecasts of electricity and petroleum in a stepwise manner. Five different functional forms are specified for this submodel. The seven functional forms of the basic model and the five functional forms of the submodel are evaluated, and preferred models selected. Forecasts are generated of the exogenous variables in the model using the Wharton annual forecasting model of the US economy. In order to make such forecasts a linkage model is developed, linking the variables of the Wharton model to the exogenous variables of the farm sector model. Forecasts from the Wharton model are fed into the linkage model to derive forecasts for the exogenous variables. The forecasts of the exogenous variables are fed into the farm sector model to derive forecasts for electricity and petroleum purchases. The different functional forms of the farm sector model are used to derive alternative estimates of energy purchases. These different estimates

are compared and a preferred set of estimates chosen. These preferred forecasts show the quantity of electricity purchased growing at a rate of just over 6% between now and the year 2000 while the quantity of petroleum declines at a rate of over 4%.

28914 **(IDO—10095) Compilation of reports on direct reduction technology and economics. Final report.** Davis, C.G.; McFarlin, J.F.; Pratt, H.R. (EG and G Idaho, Inc., Idaho Falls (USA); United States Steel Corp., Monroeville, PA. Research Lab.). Jun 1981. Contract AC07-76ID01570. 192p. NTIS, PC A09/MF A01. Order Number DE81026053.

A study was made of alternative direct-reduction (DR) processes for a steel plant sited at an east-coast or gulf-coast location for comparison with the blast furnace/basic oxygen process steelmaking at a like location. The processes surveyed incude: (1) natural-gas-based DR processes, (2) commercial and second-generation coal-based DR processes, (3) coke-oven-gas DR processes, and (4) new technology. This report presents process descriptions, energy requirements, process economics for the DR process, and comparative economics for steelmaking by alternate routes.

28915 **(NCEI—0031) Application of solar-heating technology to a batch-type industrial process.** Edwards, B.E. (Old North Mfg. Co., Inc., Lenior, NC (USA)). 1 Apr 1981. 12p. NTIS, PC A02/MF A01. Order Number DE81903377.

To conserve resources and energy in the production of Flex-Joint, an asphalt-impregnated fiber board, a new manufacturing process has been developed. The product is used to make preformed expansion joints in concrete construction. Previous industry practice was to saturate fiber board with a dilute asphalt solution by immersion or injection, then field-dry the saturated board. This resulted in the evaporation of 3 to 4 gallons of solvent into the atmosphere for each sheet of board produced. In addition to the obvious loss of resources and the potential air pollution, the drying process required as much as 3 to 4 weeks, creating problems in inventory and storage. The Sol-Cycle process provides for: (1) recycle of the solvent used in the saturation step; (2) conversion of raw to finished board in 24 hours; (3) better control of the saturation step; and (4) the use of solar energy for a part of the driving force to accomplish (1) and (2).

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 28054, 28813

28916 **(BNL—29720) Modeling energy-conservation potentials of community energy-system technologies.** Kleeman, P.T. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 8p. (CONF-810477—2). NTIS, PC A02/MF A01. Order Number DE81026059.

From 12. modeling and simulation conference; Pittsburgh, PA, USA (30 Apr 1981).

A mathematical model is presented for estimating energy-conservation potentials of community-energy-system technologies in meeting community energy service demands. The model is formulated to identify optimal community composition, technology choices, and fuel use under various fuel price, energy service demand, and other system-parameter assumptions.

28917 **(CONF-8010204—1) Indirect benefits of cogeneration district heating.** Santini, D.J.; Levine, E.P. (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG-38. 19p. NTIS, PC A02/MF A01. Order Number DE81023908.

From ASCE 1980 annual convention and exposition; Hollywood, FL, USA (27 Oct 1980).

Previous research is summarized and synthesized to develop a technology assessment which illustrates the substantial indirect environmental (employment and air pollution) benefits obtainable from implementation of a cogeneration-based district-heating technology by use of electric/thermal power plants at existing metropolitan electric plant sites. The benefits are inextricably linked to the economic market for the cogeneration district heating technology. The market is shown to be confined to downtown areas of major northern US cities because of the high heating demand density found there. Since minorities are disproportionately concentrated within these same cities, and since the technology uses more low skill labor than its alternatives, construction employment opportunities for minorities are estimated to be substantially greater than for the coal-based alternatives examined. Because the technology efficiently substitutes relatively remote high level emittors for local low level area source emittors it reduces by substantial amounts the ambient air pollution levels in the heavily used downtown area, generally with little or no total emissions increases.

28918 **(DOE/CE/24390—1) Preliminary development of a technique for estimating municipal-solid-waste generation.** (Franklin Associates, Prarie Village, KS (USA)). Jun 1981. Contract AC01-78CE24390. 84p. NTIS, PC A05/MF A01. Order Number DE81024152.

The study undertaken to examine the feasibility of improving estimation techniques of generation of residential and commercial components of municipal solid wastes is described. Several cities were contacted to obtain detailed solid-waste quantities collected by solid-waste-collection jurisdictions. The data obtained revealed detailed generation quantities by collection route for defined areas of the cities. These data were then used to test various predictive factors. The end result of the analysis is a provisional method for estimating residential solid-waste generation by relating it to income data readily available from government documents, and a provisional method for estimating commercial solid waste generation by relating it to readily available retail sales data. The analysis of the data obtained has resulted in a residential solid-waste estimation technique that can be applied to virtualy any city or region of interest. The general approach consisted of: data collection from selected solid waste jurisdictions, the determination of demographic and socioeconomic data for each solid waste jurisdiction; and data analysis. Each stage is discussed. (MCW)

28919 **(ORNL/TM—7582) Summary of the Oak Ridge ANFLOW pilot plant project.** Genung, R.K.; Hancher, C.W.; Million, D.L.; Pitt, W.W. Jr. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 154p. NTIS, PC A08/MF A01. Order Number DE81026344.

Oak Ridge National Laboratory (ORNL) has developed an energy-conserving wastewater treatment system based on an anaerobic, upflow (ANFLOW) bioreactor that uses films of bacteria fixed to inert, stationary packing material. The treatment process is based on passing wastewaters upward through the bioreactor for continuous treatment by gravitational settling, biophysical filtration, and biological decomposition. A 2-year pilot plant project using a bioreactor designed to treat 19 m^3/d (5000 gpd) has been conducted with raw wastewater on a municipal site in Oak Ridge, Tennessee. Data obtained for the performance of the bioreactor during this project have been analyzed. From these analyses, it was estimated that hydraulic loading rates of 0.008 $m^3/m^2.min$ (0.2 gpm/ft^2) and hydraulic residence times of 10 h could be used in designing such bioreactors for the secondary treatment of municipal wastewaters. Conceptual designs for total treatment systems processing up to 3800 m^3/d (1.0 million gpd) of wastewater were developed based on the performance of the pilot plant bioreactor. These systems were compared with activated-sludge treatment systems also operating under secondary treatment requirements and were found to consume as little as 30% of the energy required by the activated-sludge systems. Methane produced by anaerobic fermentation processes occurring during the biological decomposition of carbonaceous wastes also represented a significant and recoverable energy production term as wastewater flow rates approached 3800 m^3/d. ORNL is presently engaged in developing a 190-m^3/d (50,000-gpd) wastewater treatment system based on the conceptual designs developed by ORNL and AWARE. This project will be conducted jointly with the city of Knoxville, Tennessee, at the site of the Loves Creek Treatment Plant.

3209 Education And Public Relations

REFER ALSO TO CITATION(S) 28772

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 28935, 28936, 28937, 29163

28920 **(DOE/SF/01979—T1) Fuel effective general purpose farm engine: a preliminary design.** McWhorter, E.M. (McWhorter (Edward M.), Citrus Heights, CA (USA)). Jan 1979. Contract FG03-78SF01979. 46p. NTIS, PC A03/MF A01.

The major emphasis in developing a Fuel-Effective farm engine in this study has been directed principally toward the development of an engine system capable of operating on less costly alternative fuels. The study indicates that less refined heavy residual alternative fuels can be used in the small high speed diesel engine in spite of the effect of the more severe surface quenching conditions and the effect of ignition lag in the shorter residence period. The study also suggests that the use of low octane gasoline in the high compression spark ignition engine is possible without the attendant problem of detonation. The conclusions are predicted on the assumption that small variations in piston motion when operating near the TDC position, can have a pronounced effect on the combustion conditions and therefore significantly alter the ignition characteristics and burning rate of a given fuel. The conclusions reached in the preliminary design study are: (1) the required piston motion near TDC can be generated by a compound crankshaft operating in conjunction with an intra-articulate connecting rod; (2) the rate of thermal dissociaton is the principal rate controlling factor in the combustion of heavy alternative fuels; temperature management in the final compression period is imparitive to effective combustion in diesel engines; (3) pressure management during the ignition and initial combustion period is achieved by shifting the normal pressure schedule during the final compression to the downstroke side of the crank swing; and (4) exhaust gas recirculation can be achieved without performance loss by the removal of exhaust gases at the bottom of the piston stroke. This type of operation lowers the engine cooling requirements, decreases the pumping losses, increases compression ignition temperatures but decreases peak combustion temperatures decreasing the nitrogen oxide content in the exhaust stream. (WHK)

28921 **(DOE/SF/90467—T1) Revised draft program plan report for applied research in road vehicles.** (TRW Systems Group, McLean, VA (USA)). 1 Jul 1977. Contract AT03-76SF90467. 57p. NTIS, PC A04/MF A01.

The purpose of this study was to identify research areas, other than new propulsion systems, which could make significant contributions to energy conservation in the operation of highway vehicles and could thereby reduce US dependence on imported petroleum. Research programs were identified in six areas: rolling resistance, tribology applications, aerodynamic drag, combustion, advanced systems evaluation and development, and systems engineering. Potential research areas in rolling resistance are improved testing methods and prediction techniques. Tribology research areas include: studies of engine piston ring/cylinder friction, studies of the lubrication problems of adiabatic diesels and continuously variable transmissions, and studies on improved lubricants. Potential research areas in aerodynamic drag are focused in the areas of testing and prediction techniques. Potential areas for additional combustion research are the use of microprocessors and studies on ways to reduce the NO/sub x/ emissions of diesel engines. In the area of advanced systems evaluation and development, a program will be established to evaluate new research projects off the street. In the area of systems engineering, a computer program will be built to evaluate the potential of improvements under various conditions. The national energy saving potential of fuel economy improvements which could result from research in each of these areas is estimated. The need for a federal program which coordinates vehicle research studies by numerous federal agencies is discussed. Industrial efforts in the US and international activities in each area are reviewed. (LCL)

28922 **Time-resolved Raman spectroscopy in a stratified-charge engine.** Smith, J.R. (Sandia Lab, Livermore, Calif). *ACS (American Chemical Society) Symposium Series ;* No. 134, 259-268(1980). (CONF-790917—).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

The objectives were to develop techniques to measure both the mean and fluctuating nitrogen density and temperature in a combusting stratified charge engine. Such data are necessary for analytical engine model verification. The method chosen to achieve these measurements was spontaneous vibrational Raman scattering by a pulsed frequency doubled YAG laser to get a time resolution of 10 nsec. The nitrogen density was determined from the Stokes signal and the temperature was determined from the ratio of the anti-Stokes to Stokes signal. 5 refs.

3302 External Combustion Engines

REFER ALSO TO CITATION(S) 29163

28923 **(DOE/NASA/51040—29) Hostile environmental conditions facing candidate alloys for the automotive Stirling engine.** Stephens, J.R. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1981. Contract AI01-77CS51040. 13p. (CONF-810913—6). NTIS, PC A02/MF A01. Order Number DE81025915.

From International conference on environmental degradation of engineering materials; Blacksburg, VA, USA (21 Sep 1981).

A materials research program is underway at NASA Lewis Research Center in support of the DOE/NASA Automotive Stirling Engine Project. The program focuses on the hot heater head of the engine including the heater head tubes, cylinders, and regenerator housings, which are considered to be the most critical components from a materials viewpoint. The specific areas of investigation in the progam involve hydrogen permeability testing, doping of the hydrogen working fluid to reduce permeability rates, oxidation/corrosion studies, creep-rupture evaluation, and assessing effects of hydrogen environment on mechanical properties. Recent results in each of the aforementioned areas of research are described. Special emphasis is placed on the materials challenges that result from the use of hydrogen as the working fluid in this potential alternative engine to today's internal combustion engines.

3303 Electric-powered Systems

REFER ALSO TO CITATION(S) 28748, 28749

28924 **(ANL—80-128) Lithium/iron sulfide batteries for electric-vehicle propulsion and other applications. Progress report, October 1979-September 1980.** (Argonne National Lab., IL (USA)). Feb 1981. Contract W-31-109-ENG-38. 258p. NTIS, PC A12/MF A01. Order Number DE81027458.

The research, development, and management activities of the programs involving high-performance lithium-aluminum/iron sulfide batteries at Argonne National Laboratory (ANL) and at contractors' laboratories during the period October 1979 through September 1980 are reported in detail. These batteries, which are being developed for electric-vehicle propulsion and stationary energy-storage applications, consist of vertically oriented prismatic cells with one or more inner positive electrodes of FeS or FeS_2, facing negative electrodes of lithium-aluminum, and molten LiCl-KCl electrolyte. Most of the cell and battery design, development, and fabrication for the program to develop a full-scale electric-vehicle battery (designated Mark II) was subcontracted to two industrial firms - Eagle-Picher Industries, Inc. and Gould Inc. The major objective for Phase I of this program is the development of highly reliable cells which can be mass-produced at a reasonable cost. Status cells produced by both contractors have been tested at ANL. The cells produced by Eagle-Picher have exhibited high performance in the three areas tested: specific energy, specific pwer and cycle life. Delivery to ANL of a ten-cell battery module incorporating these cells is scheduled for April 1981. In the cells produced by Gould Inc., the specific energy and specific power have

been relatively high, but cycle life is still limited by two failure mechanisms which cause short circuiting. The ANL program consists of cell development studies, materials and component development, testing of cells and batteries fabricated by both ANL and its subcontractors, battery component and auxiliary systems development, and potential applications and cost studies.

28925 **(DOE/CS/51295—T1) Electric-vehicle design: design-tradeoff studies.** (ASL Engineering, Inc., Goleta, CA (USA)). Nov 1976. Contract AC03-76CS51295. 61p. NTIS, PC A08/MF A01. Order Number DE81025753.

This report presents the results of the design tradeoff studies task conducted as part of the Electric Vehicle Design Program. A baseline vehicle is presented together with an analysis of the effects of variations in vehicle and battery parameters, and alternative propulsion system configurations, on vehicle operating range, cost factors, and performance. The vehicle design which provided a basis for the tradeoff studies offers minimum seating for four people. The body is of unitized construction, in steel, with the batteries accommodated in the central tunnel. A front motor/front drive package consisting of an eleven inch frame 96 V series motor driving through a 3 speed automatic transmission (no torque convertor) is used. Motor control is by an SCR controller, and approximately 1280 pounds of lead-acid batteries are included in the 186 A-hr., 96 V battery pack. All components are existing commercial designs. The projected characteristics of the vehicle relative to the major ERDA design goals and cost estimates are presented and compared with hybrid-flywheel-electric vehicles.

28926 **(DOE/ET/13390—T1) Iron-air battery development program.** Buzzelli, E.S.; Liu, C.T.; Bryant, W.A. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). May 1980. Contract AC02-76ET13390. 110p. (COO—2949-3). NTIS, PC A06/MF A01. Order Number DE81025488.

The progress and status of the research and development program on the iron-air advanced technology battery system at the Westinghouse Electric Corporation during the period June 1978-December 1979 are described. This advanced battery system is being developed for electric vehicle propulsion applications. Testing and evaluation of 100 cm^2 size cells was undertaken while individual iron and air electrode programs continued. Progress is reported in a number of these study areas. Results of the improvements made in the utilization of the iron electrode active material coupled with manufacturing and processing studies related to improved air electrodes continue to indicate that a fully developed iron-air battery system will be capable of fulfilling the performance requirements for commuter electric vehicles.

28927 **(DOE/NASA/51044—20) Effect of voltage on the cost of an electric vehicle propulsion system.** Schuh, R.M.; McBrien, E.F. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1981. Contract AI01-77CS51044. 32p. (NASA-TM—82592; CONF-810814—4). NTIS, PC A03/MF A01. Order Number DE81025904.

From 91. national meeting of the American Institute of Chemical Engineers; Detroit, MI, USA (16 Aug 1981).

The life cycle cost and the purchase price of simple dc and ac propulsion systems are estimated as a function of battery voltage from 50 to 500 V. The results of the study show a slight preference for a battery pack voltage of approximately 100 V. Three propulsion systems are examined: one has a series motor with a chopper controller, another an induction motor with an inverter controller, and the third a shunt motor using stepped-voltage control below base speed and field control above base speed. Motor power rating is assumed to be 20 kW continuous duty. The cost and the specific energy of a 24 kW-h battery pack are estimated from 50 to 500 V by a battery manufacturer. The impact of system voltage variation on the efficiency, weight, and cost of the other electrical components is estimated from basic electrical considerations and informal discussions with manufacturers.

28928 **(SRD—78-199) Near-term electric vehicle program: Phase II, safety report. Integrated Test Vehicle WBS 6.2.6.** (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). 15 Jan 1979. Contract AC03-76CS51294. 65p. NTIS, PC A04/MF A01. Order Number DE81026850.

The characteristics of the Integrated Test Vehicle as they pertain to vehicle safety are delineated. Vehicle safety is described under three basic headings: (1) the safety characteristics of the vehicle under normal operating conditions further subcategorized into vehicle operation, vehicle charging, and vehicle maintenance (operational characteristics shall include a discussion of electromagnetic compatibility or EMC); (2) a similar and parallel discussion of the vehicle's safety characteristics during operation, charging, and maintenance under the presumption that failure of elements of vehicle hardware has in fact occurred; and (3) safety characteristics and potential hazards of the vehicle associated with or resulting from vehicle collision or upset. Discussions are based upon design considerations, compliance with applicable standards, and results of analyses and tests. (WHK)

28929 **(SRD—79-156-1) Near-term electric vehicle program. Phase II. Operation and maintenance manual.** (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). 1 Nov 1979. Contract AC03-76CS51294. 186p. NTIS, PC A09/MF A01.

A detailed description of the design, operation, and maintenance of the Integrated Test Vehicle (ITV) including instruments and controls, economy, safety and security, troubleshooting, and specifications is given. The ITV employs a dc traction motor and 18 lead-acid batteries which provide a nominal voltage of 108 Vdc. A microcomputer controls many vehicle electrical functions. The ITV is a four-passenger subcompact weighing 3320 lb curb weight with the capacity of carrying a 600 lb payload. The driving range is 75 miles on urban cycle, and the vehicle is equipped with a regenerative braking system. (WHK)

28930 **(SRD—79-156-2) Near-term electric vehicle program. Phase II. Operation and maintenance manual.** (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). Nov 1979. Contract AC03-76CS51294. 120p. NTIS, PC A06/MF A01.

As part of the Near-Term Electric Vehicle Program, this volume contains: handling, installation and maintenance instructions for Types BT 1300 and BT 2300 dc motors; a storage battery technical service manual; installation, operation, maintenance and repair information for the Model 8303-A South Wind Hot Box manufactured by the Stewart-Warner Corp.; and an installation, operation and maintenance manual for a hydraulic hoist designed to handle main battery packs. (LCL)

3304 Hybrid Systems

REFER ALSO TO CITATION(S) 28925

28931 **(CONF-810812—31) Assessment of flywheel system benefits in selected vehicle applications.** Kubo, L.H.; Forrest, L. (Aerospace Corp., Los Angeles, CA (USA); Aerospace Corp., El Segundo, CA (USA)). 1981. Contract AC08-79ET26306. 7p. NTIS, PC A02/MF A01. Order Number DE81025976.

From IECEC conference; Atlanta, GA, USA (9 Aug 1981).

The performance of vehicle systems incorporating energy storage flywheels was investigated in a recent Aerospace study for the Department of Energy. A synopsis of the study effort and of results obtained to date is presented. The effort involved an in-depth assessment of flywheel system benefits in two vehicle applications: a four-passenger commuter car with electric drive (flywheel range extension application) and a six-passenger family car with conventional heat engine drive (flywheel fuel conservation application). The special case of the six-passenger vehicle as used in taxicab service was also investigated. The study examined a number of possible component design/selection alternatives for flywheel rotors, continuously variable transmissions, batteries, motors, and other propulsion elements. Results of the assessment are provided

for the case of a series-configuration heat engine/flywheel drivetrain as used in the passenger car and urban taxi vehicle missions.

28932 (LA-UR—81-2177) Assessment of taxicab fleet operation in New York City. Krupka, M.C.; Jackson, S.V. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 7p. (CONF-810833—2). NTIS, PC A02/MF A01. Order Number DE81028779.

From Mechanical, magnetic, and underground energy storage 1981 annual contractors' review meeting; Washington, DC, USA (24 Aug 1981).

A preliminary assessment of the impacts resulting from incorporation of flywheel energy storage systems into automotive fleets in a large metropolitan city is described. Specifically, the case of taxicab fleet operation within New York City is examined. Based upon available taxicab operational data, a levelized life-cycle cost comparison between a standard internal combustion engine vehicle in present use as a taxicab and a projected hybrid flywheel-internal combustion engine vehicle (taxicab) has been generated. Energy conservation and environmental benefits are discussed and potential institutional barriers to rapid deployment of flywheel energy storage systems are identified. The results obtained from this study generally emphasize the value of incorporating flywheel energy storage systems into future vehicles designed for taxicab use.

3305 Flywheel Propulsion

REFER ALSO TO CITATION(S) 28743, 28931, 28932

28933 (DOE/DP/00789—T14) RPE-10 composite flywheel. Final report. Ginsburg, B.R. (Rockwell International Corp., Canoga Park, CA (USA). Rocketdyne Div.). Oct 1979. Contract AC04-76DP00789. 83p. NTIS, PC A05/MF A01. Order Number DE81027578.

Details of a program to design and fabricate a composite flywheel for vehicle use are presented. Design and analysis details for the fabricated wheels, the test plan to verify the total energy and energy density of the flywheel, and probable production costs of various quantities of such flywheels are given.

3306 Vehicle Design Factors

REFER ALSO TO CITATION(S) 28921, 28928

28934 (DOE/CS/51095—T1) Study on reduction of accessory horsepower requirements. Program summary report. Lefferts, C.H. (AiResearch Mfg. Co., Phoenix, AZ (USA); AiResearch Mfg. Co., Torrance, CA (USA)). 15 Jun 1977. Contract AC03-76CS51095. 196p. NTIS, PC A09/MF A01.

The objective of this program was to define, evaluate and develop automotive accessory systems to minimize engine power consumption and significantly improve fuel economy. All tasks have been completed and the program objectives have been accomplished. Information is presented on each phase of the program which involved: conceptual design to recommended component improvement and accessory drive systems; performance and sizing analyses; detail design and specifications; fabrication, and performance testing; evaluation of integrated hybrid drive, improved accessories; and an advanced air conditioning concept.

3308 Alternative Fuels

28935 (DOE/CS/51212—T4) Hydrogen-engine performance-analysis project. Second quarterly report first year of program. Adt, R.R. Jr.; Swain, M.R.; Pappas, J.M. (Miami Univ., Coral Gables, FL (USA). Dept. of Mechanical Engineering; Hawthorne Research and Testing, Inc., Coral Gables, FL (USA)). Jun 1977. Contract AC03-77CS51212. 50p. NTIS, PC A04/MF A01.

The objective of this research effort is to obtain the design data-base covering performance, operational characteristics and emissions essential for making a rational decision regarding the selection and design of prototype hydrogen-fueled, air-breathing engines capable of being manufactured for general automotive use. To this end hydrogen-fueled internal combustion engines were divided into fourteen subgroups. An engine representative of each subgroup will be tested during the course of the three year program. The Project Program Plan calls for investigation of pre-intake valve closing fuel ingestion (Pre IVC) hydrogen-fueled engines during the first two years. Work accomplished during the second three months of the project is reported. Activities during the second quarter concentrated on: final apparatus debugging, engine break-in, preliminary testing to determine qualitative apparatus operating characteristics, rearranging of the proposal test schedule and performing of tests with engine 1 (carbureted, throttled, no H_2O injection, no EGR and engine 4 (carbureted, unthrottled, no H_2O injection, no EGR. The details of these activities are described.

28936 (DOE/CS/51212—T5) Hydrogen-engine performance-analysis project. Third quarterly report first year of program. Adt, R.R. Jr.; Swain, M.R.; Pappas, J.M. (Miami Univ., Coral Gables, FL (USA). Dept. of Mechanical Engineering; Hawthorne Research and Testing, Inc., Coral Gables, FL (USA)). Sep 1977. Contract AC03-77CS51212. 20p. NTIS, PC A02/MF A01.

The objective of this research effort is to obtain the design data-base covering performance, operational characteristics and emissions essential for making a rational decision regarding the selection and design of prototype hydrogen-fueled, air-breathing engines capable of being manufactured for general automotive use. To this end hydrogen-fueled internal combustion engines were divided into fourteen subgroups. An engine representative of each subgroup will be tested during the course of the three year program. The Project Program Plan calls for investigation of pre-intake valve closing fuel ingestion (Pre IVC) hydrogen-fueled engines during the first two years. Work accomplished during the third 3-month period of the project is reported. Activities in this quarter included: water injection experiments with the throttled and unthrottled engine mode of operation; design and construction of exhaust gas recirculation (EGR) equipment for use with the EGR experiments with the throttled and unthrottled engine configuration; construction of lithium-filled exhaust valves; and analysis of data for annual report preparation purposes. (LCL)

28937 (DOE/CS/51737—T1) Alcohol fueled automobiles: performance - emissions - environment. (Santa Clara Univ., CA (USA)). 23 Oct 1979. Contract AC03-78CS51737. 18p. NTIS, PC A02/MF A01. Order Number DE81026792.

Topics include: (1) alcohol fueled vehicles: economy and emissions; (2) cold starting experiments with neat methanol; (3) emissions and fuel economy tests on a Toyota Supra using methanol and ethanol blends; (4) thermokinetic modeling of alcohol-fueled engines; (5) smog chamber comparisons of alcohol and gasoline exhausts; and (6) environmental toxicity comparison of alcohol fuels and gasoline. (WHK)

28938 (DPST—80-634) Natural gas and methane as vehicle fuels at SRP. Steimke, J.L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 9 Mar 1981. Contract AC09-76SR00001. 11p. NTIS, PC A02/MF A01. Order Number DE81028767.

The practicality of altering the 700 gasohol-consuming vehicles in the Savannah River Fleet to run on compressed gas or methane is examined. Pipeline natural gas would be purchased or water hyacinths could be grown in ponds at SRP and anaerobically digested to generate methane. Conversion of vehicles to natural gas using a kit, safety considerations, fuel characteristics of natural gas, and costs of converting to natural gas fuel are briefly discussed. The production procedures for hyacinths, the mass that would be required, the water acreage and fertilizers needed, harvesting and transport expenses, operation and performance of the digester, and yields from the digester are also discussed briefly. In sum, it is economically attractive to fuel plant vehicles with natural gas and technically feasible to utilize hyacinths to generate methane, but expensive. (MCW)

36 MATERIALS

28939 (ORNL/TM—7612) Advanced research and technology development fossil energy materials program plan for FY 1981. Bradley, R.A.; Judkins, R.R. (comps.). (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 179p. NTIS, PC A09/MF A01. Order Number DE81025776.

This is the second annual plan. Background, technical issues, and needed programs are discussed for construction materials for coal mining, cleaning, beneficiation, and handling; coal liquefaction; coal gasification; heat engines and heat recovery; combustion systems; fuel cells; MHD; oil shale; and information storage and technology transfer. Separate abstracts were prepared for six of these sections. The sections not thus treated separately relate to coal mining, cleaning, beneficiation, and handling; MHD; and information storage and technology transfer. (DLC)

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 28033, 28034, 28069, 28301, 28307, 28355, 28494, 28671, 28676, 28734, 28734, 28752, 28755, 28846, 28923, 29192

28940 (ORNL-tr—4765) Method of manufacturing hot press formed products. Ishii, M. (Oak Ridge National Lab., TN (USA)). [nd]. Translation of . Japanese Patent 1975-158,605. 11p. NTIS, PC A02/MF A01. Order Number DE81027616.

Method is described for manufacturing hot press formed products, characterized by the fact that a mixture, whose weights of titanium diboride, boron nitride, and combined weight of aluminum and titanium are within the area bounded by the points A (55, 20, 25), B (75, 20, 5), C (30, 65, 5), and D (30, 45, 25). The aluminum and titanium component is a mixture of fine powders in which the aluminum:titanium mix ratio is in the range 3:1 ~ 1:20, is heated to 1600 to 2300°C in a nonoxidizing atmosphere and press formed while hot.

28941 (BNL—29672) Adsorption of hydrogen on iron and the hydrogen embrittlement of steel. Sieradzki, K.; Ficalora, P.J. (Brookhaven National Lab., Upton, NY (USA); Oak Ridge National Lab., TN (USA)). 1981. Contract AC02-76CH00016. 13p. (CONF-810913—4). NTIS, PC A02/MF A01. Order Number DE81025164.

From International conference on environmental degradation of engineering materials; Blacksburg, VA, USA (21 Sep 1981).

The mechanical properties of certain steels become severely degraded in the presence of a hydrogen environment. It is generally accepted that adsorption of hydrogen on to the surface of the steel is the first step in this phenomenon known as hydrogen embrittlement. A review of the literature with respect to hydrogen adsorption on iron and hydrogen embrittlement reveals that good correlations between the two do exist. A model for the chemisorption of hydrogen on iron is developed and the calculated energies of the adsorbed states agree well with observed experimental values. The model is used to explain some of the experimental observations associated with the hydrogen embrittlement of steels. For example, the observed temperature dependence of crack growth rates can be readily interpreted within the framework of the model. The indications are that adsorption may be the key step in the embrittlement process. 4 figures, 2 tables.

28942 (CONF-800864—3) Electronic structure and many-body effects in Pd. Crabtree, G.W.; Dye, D.H.; Campbell, S.A.; Ketterson, J.B.; Vuillemin, J.J.; Sandesara, N.B. (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01. Order Number DE81023110.

From International conference on physics of transition metals; Leeds, UK (18 Aug 1980).

Phase-shift parametrization for the Fermi surface properties of Pd was constructed using extremal orbital areas and cyclotron masses measured with the de Haas-van Alphen effect. (GHT)

28943 (DOE/ER—0046/5) Damage analysis and fundamental studies. Quarterly progress report, January-March 1981. (Westinghouse Hanford Co., Richland, WA (USA)). May 1981. Contract AC14-76FF02170. 256p. NTIS, PC A12/MF A01. Order Number DE81026658.

The DAFS program element is a national effort composed of contributions from a number of National Laboratories and other government laboratories, universities, and industrial laboratories. It was organized by the Materials and Radiation Effects Branch, Office of Fusion Energy, DOE, and a Task Group on Damage Analysis and Fundamental Studies, which operates under the auspices of that Branch. The purpose of this series of reports is to provide a working technical record of that effort for the use of the program participants, the fusion energy program in general, and the DOE.

28944 (DOE/ER/01198—1356) Contribution to the characterization of the anelastic properties of multi-phase systems. Mazzolai, F.M. (Illinois Univ., Urbana (USA). Materials Research Lab.). 1981. Contract AC02-76ER01198. 12p. (CONF-8106105—2). NTIS, PC A02/MF A01. Order Number DE81025581.

From International conference on internal friction and acoustic attenuation of solids; Lausanne, Switzerland (Jun 1981).

A characterization of the various kinds of acoustical effects associated with phase transformations is presented. Some previous theoretical approaches and experimental results concerning diffusion - assisted processes are briefly outlined, mainly for the purpose of illustrating the contributions given to this subject by the present conference.

28945 (DOE/ER/05002—T2) Molecular dynamics simulation of grain-boundary diffusion of vacancies in bcc iron. Kwok, T.; Ho, P.S.; Yip, S.; Balluffi, R.W.; Bristowe, P.D.; Brokman, A. (Massachusetts Inst. of Tech., Cambridge (USA)). Jun 1981. Contract AS02-78ER05002. 14p. (COO—5002-22). NTIS, PC A02/MF A01. Order Number DE81025540.

The jumping of vacancies in a bcc iron $\Sigma = 5$ tilt boundary was simulated by computer molecular dynamics. The data yielded a reasonable value of the activation energy for migration and showed that the jump processes are highly structure-dependent. The use of a temperature dependent transition probability matrix to describe the diffusion of the vacancies in the grain boundary is suggested. Formation of one type of boundary interstitial was observed which was found to be immobile.

28946 (DOE/ER/05002—T3) Determination of vacancy mechanism for grain boundary self-diffusion by computer simulation. Balluffi, R.W.; Kwok, T.; Bristowe, P.D.; Brokman, A.; Ho, P.S.; Yip, S. (Massachusetts Inst. of Tech., Cambridge (USA)). Jun 1981. Contract AS02-78ER05002. 7p. (COO—5002-23). NTIS, PC A02/MF A01. Order Number DE81025539.

It is currently well established that the fast self-diffusion which occurs along grain boundaries (GBs) in metals must occur by a point defect exchange mechanism. For example, it is known that rapid GB diffusion can transport a net current of atoms along GBs during both sintering and diffusional creep, and that the two species in a binary substitutional alloy diffuse at different rates in GBs. However, it has not been possible to establish firmly whether the defect mechanism involves the exchange of atoms with vacancy or interstitial point defects. It has been suspected that the vacancy exchange mechanism must apply but it has been difficult to prove this hypothesis because of a lack of detailed information at the atomistic level. The results are presented of an effort to establish the GB self-diffusion mechanism in a bcc iron $\Sigma = 5$ (36.9°) [001] (310) tilt boundary using the combined methods of computer molecular statics and molecular dynamics simulation.

28947 **(DOE/ET/12075—T1) High-temperature oxidation and nitridation of niobium in ultrahigh vacuum. Final report, July 1, 1963-October 31, 1964.** Pasternak, R.A. (California Univ., Los Angeles (USA); Stanford Research Inst., Menlo Park, CA (USA)). 15 Nov 1964. Contract AT03-76ET12075. 65p. NTIS, PC A04/MF A01. Order Number DE81026549.

An intensive ultrahigh vacuum study of the interaction of nitrogen or oxygen, and of nitrogen-oxygen mixtures with clean niobium has been carried out. For nitrogen the kinetics of adsorption, of absorption, and of degassing has been investigated, and the thermodynamic equilibrium for solution of nitrogen in niobium has been determined. Detailed mechanisms for these processes have been formulated which explain reasonably well the experimental data. The study of the oxygen-niobium system resulted in data on the adsorption and absorption processes similar to that for nitrogen. In addition, dissociation of oxygen molecules on the hot metal surface and evaporation of a volatile niobium oxide from the hot sample were observed. The reaction of nitrogen-oxygen mixtures at low pressures with niobium cannot be explained on the basis of independent sorption of the individual gases with niobium. Possibly a catalytic reaction leading to nitrogen oxides may occur; the formation of stable surface layers containing both nitrogen and oxygen is also indicated.

28948 **(DOE/ET/13513—T11) WEC 3.2.3 study to optimize Cr-Mo steels to resist hydrogen and temper embrittlement. Quarterly report No. 7, February 15-May 15, 1980.** Shaw, B.J. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). 20 Oct 1980. Contract AC05-78ET13513. 35p. NTIS, PC A03/MF A01. Order Number DE81026355.

Purpose of Phase I was to establish the hydrogen embrittlement susceptibility of commercial 2-1/4 Cr-1Mo steels provided by API. Purpose of Phase II was to evaluate 32 laboratory heats tempered in a bainitic condition to two strength levels. These laboratory heats have been cast and forged, and this report gives the analytical chemistry and the metallograhic characterization of the heats. 32 figures, 7 tables. (DLC)

28949 **(DOE/NASA/2593—23) Material response from Mach 0.3 burner rig combustion of a coal-oil mixture.** Santoro, G.J.; Calfo, F.D.; Kohl, F.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jun 1981. Contract AI01-77ET10350. 24p. (NASA-TM—81686). NTIS, PC A02/MF A01. Order Number DE81027073.

Wedge-shaped specimens were exposed to the combustion gases of a Mach 0.3 burner rig fueled with a mixture of 40 weight percent micron-size coal particles dispersed in No. 2 fuel oil. Exposure temperature was about 900°C and the test duration was about 44 one-hour cycles. The alloys tested were the nickel-base superalloys, IN-100, U-700 and IN-792, and the cobalt-base superalloy, Mar-M509. The deposits on the specimens were analyzed and the extent of corrosion/erosion was measured. The chemical compositions of the deposits were compared with the predictions from an equilibrium thermodynamic analysis. The experimental results were in very good agreement with the predictions.

28950 **(DP-MS—81-27) Deuterium permeation and surface effects.** Stone, J.M. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1981. Contract AC09-76SR00001. 19p. (CONF-810913—3). NTIS, PC A02/MF A01. Order Number DE81024394.

From International conference on environmental degradation of engineering materials; Blacksburg, VA, USA (21 Sep 1981).

It is proposed that a surface film on a metal may limit hydrogen isotope permeability by limiting adsorption and/or dissociation as well as by acting as a simple barrier of low permeability. Stainless steel samples with many surface modifications were measured for deuterium permeability to attempt to determine the role of surface effects in permeability and to determine in which systems the effect is operative. Both metallic and oxide surface films are included. A model is proposed which shows there are as many as seven steps in th permeation of a hydrogen isotope through a membrane. The model holds that, when a permeation limiting surface effect is present, the reduced permeation is actually a reflection of reduced surface concentration at the hydrogen facing side of the membrane.

28951 **(DP-MS—81-31) Hydrogen damage in stainless steel.** Caskey, G.R. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1981. Contract AC09-76SR00001. 32p. (CONF-810913—1). NTIS, PC A03/MF A01.

From International conference on environmental degradation of engineering materials; Blacksburg, VA, USA (21 Sep 1981).

Hydrogen damage has been studied in a wide variety of stainless steels. Both internal and external hydrogen damage were evaluated by ductility or J-integral under rising tensile loads and by fractography. Analysis of the data has emphasized the potential effects of strain-induced martensite on hydrogen damage. Strain-induced martensite was neither necessary nor sufficient for hydrogen damage in the alloys studied. Neither ductility loss nor fracture-mode change correlated generally with martensite formation. Alloy composition, particularly nickel and nitrogen contents, was the primary factor in resistance to hydrogen damage. Thermomechanical processing, however, could alter the degree of hydrogen damage in an alloy and was critical for optimizing resistance to hydrogen damage. 10 figures, 10 tables.

28952 **(EGG-FM—5051) High-speed cinematography of gas-tungsten arc welding: theory and application.** Reynolds, L.D.; Key, J.F. (Idaho National Engineering Lab., Idaho Falls (USA)). Jun 1981. Contract AC07-76ID01570. 87p. NTIS, PC A05/MF A01. Order Number DE81028272.

High-speed photo-instrumentation theory and application are reviewed, with particular emphasis on high-speed cinematography, for the engineer who has not acquired an extensive background in scientific photography. Camera systems, optics, timing system, lighting, photometric equipment, filters, and camera mounts are covered. Manufacturers and other resource material are listed in the Appendices. The properties and processing of photosensitive materials suitable for high-speed photography are reviewed, and selected film data are presented. Methods are described for both qualitative and quantitative film analysis. This technology is applied to the problem of analyzing plasma dynamics in a gas-tungsten welding arc.

28953 **(HEDL—6817) DAFS contribution quarterly specimen matrix in the AD-2 irradiation experiment.** Peterson, D.T.; Odette, G.R. (Hanford Engineering Development Lab., Richland, WA (USA)). 1980. Contract AC14-76FF02170. 5p. NTIS, PC A02/MF A01. Order Number DE81026509.

The AD-2 experiment will begin irradiation in the EBR-II reactor in August 1980. Specimens provided by the DAFS program were included in the experiment. The specimens are transmission electron microscopy (TEM) disks of several ferritic alloys including two pressure vessel steels and several iron-nickel-chromium alloys. These specimens are being irradiated in EBR-II to study their response to neutron irradiation in a fast neutron environment.

28954 **(HEDL—6899) HEDL contribution to ADIP development specimens and test methods.** Wire, G.L. (Hanford Engineering Development Lab., Richland, WA (USA)). 1980. Contract AC14-76FF02170. 26p. NTIS, PC A03/MF A01. Order Number DE81026482.

HT-9 fracture toughness specimens were fatigue precracked using an electropotential technique to monitor the precrack length. A calibration curve was developed from optical crack measurements. The status of MFE-5 in-reactor fatigue crack growth experiment is reported. Miniature tensile testing of 316 stainless steel is also reported. (MOW)

28955 **(HEDL—6917) Contribution to DAFS quarterly yield-strength correlation for 20% CW 316 stainless steel.** Simons, R.L. (Hanford Engineering Development Lab., Richland, WA (USA)). 1981. Contract AC14-76FF02170. 20p. NTIS, PC A02/MF A01. Order Number DE81026489.

Yield strength data on 20% cold worked 316 stainless steel irradiated in fast and thermal reactors and by 14 MeV neutrons

were analyzed and a ten parameter equation was developed to describe the yield strength behavior for the temperature range 25 < T < 800°C. The equation includes the irradiation parameters: displaced atoms, helium content, and irradiation temperature. It is applicable to strain rates < 5 x 10^{-4}/second and test temperatures approximately equal to the irradiation temperature.

28956 **(HEDL—6930) Microstructural development of 20% cold worked 316 irrdiated in EBR-II.** Brager, H.R.; Garner, F.A. (Hanford Engineering Development Lab., Richland, WA (USA)). 1980. Contract AC14-76FF02170. 8p. NTIS, PC A02/MF A01. Order Number DE81026497.

This study was undertaken in order to determine the effects of neutron energy spectra on the microchemical and microstructural development in a cold worked type 316 stainless steel irradiated to high neutron fluences. (MOW)

28957 **(HEDL—6932) ADIP ORNL contribution: 12th ADIP quarterly progress report for period October-December 1980.** Puigh, R.; Duncan, D.; Ermi, A.M.; Gelles, D.; Zimmerchied, M. (Hanford Engineering Development Lab., Richland, WA (USA)). 1980. Contract AC14-76FF02170. 88p. NTIS, PC A05/MF A01. Order Number DE81026503.

The following ADIP tasks are reported on: MFE-5 in-reactor fatigue crack growth in 316 SS in ORR, titanium alloy tensile properties after neutron irradiation in EBR-II, voids in neutron-irradiated Ti alloys, fabrication of ferritic alloys for RB-1 experiment in HFIR, microstructural examination of commercial ferritic alloys irradiated to very high fluence, microstructural examination of HT-9 archive material from the AD-2 test, and swelling of commercial alloys irradiated to a very high fluence. (DLC)

28958 **(HEDL—6953) Nuclear data for damage studies and FMIT (WH025/EDK).** Johnson, D.L.; Mann, F.M. (Hanford Engineering Development Lab., Richland, WA (USA)). Apr 1981. Contract AC14-76FF02170. 6p. NTIS, PC A02/MF A01. Order Number DE81026480.

Evaluation of deuteron induced activation of gold and aluminum was done and residual doses were calculated. An evaluation was made of the neutron spectra and flux-volume for a 30 and 32 MeV deuteron beam in the FMIT test cell for comparison to the nominal 35 MeV beam.

28959 **(LA-UR—81-1768) Spallation in ductile void growth.** Johnson, J.N. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 5p. (CONF-810684—39). NTIS, PC A02/MF A01. Order Number DE81025373.

From APS conference on shock waves in condensed matter; Menlo Park, CA, USA (23 Jun 1981).

A mathematical model of ductile void growth under the application of a mean tensile stress is applied to the problem of spallation in solids. Calculation of plate-impact spallation in copper (peak compressive stress ~ 29 kbar) shows good agreement with the dynamically measured spall signal. A second calculation, using identical material parameters, of explosively produced spallation in copper (peak compressive stress ~ 250 kbar) does very well in reproducing experimentally observed multiple spall thicknesses as observed by dynamic x-radiographic techniques. This theoretical model thus appears applicable to a wide range of dynamic uniaxial-strain loading conditions, bridging a gap that has been thought to exist for some time.

28960 **(LA-UR—81-1897) Quasi-elastic high-pressure waves in 2024 Al and Cu.** Morris, C.E.; Fritz, J.N.; Holian, B.L. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 6p. (CONF-810684—29). NTIS, PC A02/MF A01. Order Number DE81025334.

From APS conference on shock waves in condensed matter; Menlo Park, CA, USA (23 Jun 1981).

Release waves from the back of a plate slap experiment are used to estimate the longitudinal modulus, bulk modulus and shear strength of the metal in the state produced by a symmetric collision. The velocity of the interface between the metal target and a window material is measured by the axially symmetric magnetic (ASM) probe. Wave profiles for initial states up to 90 GPa for 2024 Al and up to 150 GPa for Cu have been obtained. Elastic perfectly-plastic (EPP) theory cannot account for the results. A relatively simple quasi-elastic plastic (QEP) model can.

28961 **(LBL—12289) Determination of exact orientation relationships between martensite and austenite in steels by microdiffraction.** Sarikaya, M. (Lawrence Berkeley Lab., CA (USA)). Mar 1981. Contract W-7405-ENG-48. 10p. (CONF-810811—1). NTIS, PC A02/MF A01.

From Electron microscopy Society of America meeting; Atlanta, GA, USA (13 Aug 1981).

A significant number of investigations have been performed on the determination of orientation relationships (OR) in high carbon, plate-martensitic steels. However, very little is known on the exact nature of ORs in technologically important lath martensitic steels. In a series of low alloy steels with carbon contents between 0.1 to 0.4 wt%, the existence of retained austenite as thin films (~ 200 A thick) around the martensite lath boundaries makes it possible to do direct crystallographic analysis between martensite and austenite by microdiffraction.

28962 **(LBL—12843) Effect of vanadium on dual phase Fe/Mn/Si/0.1C steels.** Nakagawa, A.H. (Lawrence Berkeley Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 50p. NTIS, PC A03/MF A01. Order Number DE81025681.

Thesis.

This investigation is concerned with the effect of a 0.12% vanadium addition on a Fe/1.2Mn/0.6Si/0.1C dual phase steel. A comparison of structure and mechanical properties was made between these two alloys with and without vanadium. Two phase ($\alpha + \gamma$) and singla phase (γ) annealing treatments were followed by a wide range of cooling rates. In most cases, vanadium did not have a significant beneficial effect on the mechanical properties, although it changed the microstructure. The vanadium addition caused precipitation of vanadium carbide in the ferrite and a decrease in the ferrite grain size.

28963 **(LBL—12851) High temperature corrosion of iron in sulfur containing atmospheres.** Yang, F.C.T. (Lawrence Berkeley Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 69p. NTIS, PC A04/MF A01. Order Number DE81025682.

Thesis.

The simultaneous oxidation-sulfidation of pure iron in SO_2-CO_2 and SO_2-O_2 atmosphere has been studied at 871°C. Although thermodynamic calculations predict the formation of an oxide layer, complex product layers of oxide and sulfide duplex structure are observed. The outer product layer is an oxide matrix, containing sulfide-rich streaks. The inner layer is porous and also contains sulfides. The rough surface of the oxidized sample is caused by protrusions on the outer scale. The protrusions are thought to grow by the fast transport of iron ions through the sulfide-rich streaks.

28964 (NBSIR—81-1645, pp 11-16) **Structural alloys program.** Reed, R.P. (National Bureau of Standards, Boulder, CO). Apr 1981. NTIS, PC A99/MF A01.

In Materials studies for magnetic fusion energy applications at low temperatures. IV.

An overview of the structural alloys program is presented. Selection and properties of the alloys under study are discussed, and the objectives of the program in the current fiscal year (1981) are set forth.

28965 (NBSIR—81-1645, pp 37-76) **Strength and toughness relationship for interstitially strengthened AISI 304 stainless steels at 4 K.** Tobler, R.L.; Read, D.T.; Reed, R.P. (National Bureau of Standards, Boulder, CO). Apr 1981. NTIS, PC A99/MF A01.

In Materials studies for magnetic fusion energy applications at low temperatures. IV.

A study was conducted to determine the effects of carbon and nitrogen on the 4-K fracture properties of Fe-18-Cr-10Ni austenitic stainless steels having a base composition corresponding to AISI 304. J-integral fracture toughness tests using 24.5-mm-thick compact specimens (TL orientation) were performed in a liquid helium environment on nine steel heats having carbon plus nitrogen

(C + N) contents between 0.067 and 0.325 wt.%. The fracture toughness decreased with increasing C + N content. The K/sub Ic/ estimates obtained at 4 K ranged from 337 to 123 MPa m/sup 1/2/, exhibiting an inverse dependence on tensile yield stress. A computer-aided J-integral test facility was implemented to conduct this study. This new facility improves measurement accuracy, conserves material specimens and testing time, and systematizes test procedures.

28966 (NBSIR—81-1645, pp 77-100) **Tensile and fracture properties of manganese-modified Fe-18Cr-8Ni type austenitic stainless steels.** Tobler, R.L.; Reed, R.P. (National Bureau of Standards, Boulder, CO). Apr 1981. NTIS, PC A99/MF A01.

In Materials studies for magnetic fusion energy applications at low temperatures. IV.

A series of ten low-carbon AISI-304-type austenitic stainless steels having 1 to 6% Mn (by weight) and 0.1 to 0.2% N were produced and tested to determine the effect of these elements on properties at 4 K. Tensile tests (at 295, 76, and 4 K) and J-integral fracture toughness tests (at 4 K) were conducted on developmental steels containing 18.25 to 19.50% Cr, 7.9 to 8.75% Ni, and 0.02 to 0.03% C. All steels were hot-rolled at 1450 K (2150°F) from ingots to 25.4-mm (1-inch) plates. The 4-K yield strengths ranged from 620 MPa (90 ksi) to 1068 MPa (155 ksi), increasing strongly with nitrogen content. Unacceptable low toughness was observed in the low manganese compositions, but the fracture toughnesses of alloys containing 6% Mn were equivalent to those of conventional AISI 304 stainless steels.

28967 (NBSIR—81-1645, pp 101-129) **Interstitial carbon and nitrogen effects on the cryogenic fatigue crack growth of AISI 304 type stainless steels.** Tobler, R.L.; Reed, R.P. (National Bureau of Standards, Boulder, CO). Apr 1981. NTIS, PC A99/MF A01.

In Materials studies for magnetic fusion energy applications at low temperatures. IV.

Constant-load-amplitude fatigue crack propagation (FCP) rate measurements are reported for AISI 304 type stainless steels having variable carbon-plus-nitrogen (C + N) contents. Rates at stress-intensity factors from 20 to 70 MPa m/sup 1/2/ were measured using 25-mm-thick compact specimens. The Fe-18Cr-10Ni steels tested exhibited partial martensitic phase transformations during tests at 76 and 4 K, but not during tests at 295 K. At high C + N contents (0.187 wt.% or greater), the FCP resistance was lower at 4 K than at 295 K. At low C + N contents (0.067 wt.%), the FCP resistance at cryogenic temperature was significantly higher than at room temperature. The improvement in steels of low C + N contents was associated with a transition from partially intergranular failure at 295 K to completely transgranular failure at 76 and 4 K.

28968 (NBSIR—81-1645, pp 131-146) **Anomalous yielding, transformation, and recovery effects in AISI 304L stainless steels.** Tobler, R.L.; Beekman, D.H.; Reed, R.P. (National Bureau of Standards, Boulder, CO). Apr 1981. NTIS, PC A99/MF A01.

In Materials studies for magnetic fusion energy applications at low temperatures. IV.

Experiments describing the temperature dependence of yielding and anomalous stress-stain behaviors of metastable AISI 304L stainless steels were performed. In these steels transformation to α' bcc martensite can be induced by thermal cycling or creep at stresses significantly lower than those required to form α' by simple monotonic tensile loading. A recovery phenomenon is observed for tensile specimens unloaded and warmed to 295 K after plastic strain at 76 K.

28969 (NBSIR—81-1645, pp 147-183) **Low-temperature dependence of yielding in AISI 316 stainless steels.** Tobler, R.L.; Reed, R.P. (National Bureau of Standards, Boulder, CO). Apr 1981. NTIS, PC A99/MF A01.

In Materials studies for magnetic fusion energy applications at low temperatures. IV.

Tensile tests at temperatures between 323 and 4 K were performed on one heat of AISI 316 austenitic stainless steel having the composition Fe-17.34Cr-12.17Ni-1.55Mn-2.16Mo-0.051C. The temperature dependences of the yield and flow strengths at plastic strain increments from 0.2 to 3.65% are analyzed. At the yield strain (0.2%), no body-centered cubic (bcc) martensite phase transformation is detected. At higher strains (~3.2 +- 0.6%), bcc martensite forms from the parent austenite phase at test temperatures below 190 K, but there are no discontinuities in the temperature dependence of flow strength. A review of data available for three heats of AISI 316 at temperatures between 973 and 4 K reveals that deviations from thermally activated plastic flow theory occur at temperatures below 175 K, apparently depending on heat-to-heat compositional variations. Grain size and magnetic transition effects on the yield strength are discussed.

28970 (NBSIR—81-1645, pp 185-201) **Low-temperature deformation of 5083-0 aluminum alloy.** Tobler, R.L.; Reed, R.P. (National Bureau of Standards, Boulder, CO). Apr 1981. NTIS, PC A99/MF A01.

In Materials studies for magnetic fusion energy applications at low temperatures. IV.

This paper describes the temperature dependence of the yield strength and stress-strain characteristics for 5083-0 aluminum alloy. New experimental data in the temperature range 4 to 340 K are compared with previously published data extending to the melting point. Thermally activated plastic deformation apparently governs the behavior between 4 and 400 K, but the athermal component is not simply a function of the shear modulus. Aspects of serrated yielding and load-versus-displacement control tensile tests are discussed.

28971 (NBSIR—81-1645, pp 203-213) **Effects of carbon and nitrogen on the elastic constants of stainless steel 304.** Ledbetter, H.M. (National Bureau of Standards, Boulder, CO). Apr 1981. NTIS, PC A99/MF A01.

In Materials studies for magnetic fusion energy applications at low temperatures. IV.

Nine stainless-steel 304-type alloys were studied at room temperature. Carbon-plus-nitrogen contents of these alloys ranged from 0.067 to 0.325 weight percent (0.3 to 1.3 atomic percent). Five elastic constants - longitudinal modulus, Young's modulus, shear modulus, bulk modulus, and Poisson's ratio - were determined by a pulse-echo ultrasonic method. Within an experimental uncertainty of about 0.1 percent, all the elastic constants remain unaffected by carbon and nitrogen additions.

28972 (NBSIR—81-1645, pp 215-226) **Low-temperature variability of stainless-steel-304 elastic constants.** Ledbetter, H.M. (National Bureau of Standards, Boulder, CO). Apr 1981. NTIS, PC A99/MF A01.

In Materials studies for magnetic fusion energy applications at low temperatures. IV.

By measuring ultrasonic velocities, the elastic-constant behavior of four stainless-steel 304-type alloys was determined between ambient and liquid-helium temperatures. Despite their equivalence near room temperature, results show that cooling through the magnetic transition produces slightly different elastic constants in different alloys at low temperatures.

28973 (NBSIR—81-1645, pp 227-236) **Predicted single-crystal elastic constants of stainless steel 304.** Ledbetter, H.M. (National Bureau of Standards, Boulder, CO). Apr 1981. NTIS, PC A99/MF A01.

In Materials studies for magnetic fusion energy applications at low temperatures. IV.

The three single-crystal elastic constants - C_{11}, C_{12}, C_{44} - of stainless steel 304 are estimated from the polycrystalline bulk and shear moduli together with an empirical C_{12}/C_{11} value, which is discussed theoretically. The estimate involves a reverse Kroener method for relating single crystal and polycrystalline elastic constants.

28974 (NBSIR—81-1645, pp 237-255) **Elastic-constant/temperature behavior of three hardened maraging steels.** Ledbetter, H.M.; Austin, M.W. (National Bureau of Standards, Boulder, CO). Apr 1981. NTIS, PC A99/MF A01.

In Materials studies for magnetic fusion energy applications at low temperatures. IV.

Elastic constants of three maraging steels were determined by measuring ultrasonic velocities. Annealed steels show slightly lower bulk moduli and considerably lower shear moduli than hardened steels. All the elastic constants - Young's modulus, shear modulus, bulk modulus, and Poisson's ratio - show regular temperature behavior between 76 K and 400 K. Young's and shear moduli increase with increasing yield strength, but the bulk modulus and Poisson's ratio are relatively unchanged. Elastic anisotropy is quite small.

28975 (NBSIR—81-1645, pp 257-269) **Temperature behavior of Young's moduli of forty engineering alloys.** Ledbetter, H.M. (National Bureau of Standards, Boulder, CO). Apr 1981. NTIS, PC A99/MF A01.

In Materials studies for magnetic fusion energy applications at low temperatures. IV.

Young's-modulus and temperature data are collected graphically and tabularly for forty alloys that have technological applications. Alloy base metals include: aluminum, copper, iron, and nickel. Sources of data are: handbooks, original research at NBS, and the scientific-engineering literature. The temperature range 0 to 590 K (-460 to 600°F) is covered.

28976 (NBSIR—81-1645, pp 273-287) **Evaluation of weldments and castings for liquid helium service.** Whipple, T.A.; McHenry, H.I. (National Bureau of Standards, Boulder, CO). Apr 1981. NTIS, PC A99/MF A01.

In Materials studies for magnetic fusion energy applications at low temperatures. IV.

The FY80 results of the NBS program on the evaluation of weldments and castings for liquid helium service are reviewed. The welding process study for stainless steel castings and the study on the toughness of 5183 aluminum weldments were completed during FY80, and studies on the toughness of stainless steel castings and the fracture and deformation phenomena in duplex austenite/ferrite structures were begun. The research planned for FY81 is also reviewed.

28977 (NBSIR—81-1645, pp 289-302) **Strength and toughness of fully austenitic stainless steel filler metals at 4 K.** Elmer, J.W.; McHenry, H.I.; Whipple, T.A. (National Bureau of Standards, Boulder, CO). Apr 1981. NTIS, PC A99/MF A01.

In Materials studies for magnetic fusion energy applications at low temperatures. IV.

Several experimental fully austenitic stainless steel welds have been prepared by filler metal suppliers in the United States, Austria, Sweden and the Soviet Union. The strength and toughness of these welds have been tested and are reported at 4 K. Some Charpy impact toughness and tensile data at temperatures other than 4 K are presented. These data were reported by the suppliers. Four of the eight welds that were tested had strength-toughness combinations comparable to that of austenitic base metals. Of these four welds, three did not exhibit microfissuring that is generally present in fully austenitic welds.

28978 (NBSIR—81-1645, pp 303-321) **Weld process study for 316L stainless steel weld metal for liquid helium service.** Whipple, T.A. (National Bureau of Standards, Boulder, CO); Kotecki, D.J. Apr 1981. NTIS, PC A99/MF A01.

In Materials studies for magnetic fusion energy applications at low temperatures. IV.

This study was conducted to determine the effects of welding process choice on the cryogenic properties of 316L stainless steel welds. Six weldments were impact tested down to 77 K and tensile and fracture toughness tested down to 4 K. The best properties obtained were from a GTA weld, followed by GMA welds; SA welds had the poorest properties. This variation in properties was attributed to the cleanliness of the weld metal, which is dependent on the welding process and parameters selected.

28979 (NBSIR—81-1645, pp 323-335) **Fracture toughness properties of welds in aluminum alloy 5083-0 at 4 K.** Elmer, J.W.; McHenry, H.I. (National Bureau of Standards, Boulder, CO). Apr 1981. NTIS, PC A99/MF A01.

In Materials studies for magnetic fusion energy applications at low temperatures. IV.

A series of weldments was prepared by five cooperating companies in 51-mm thick 5083-0 aluminum plate using 5183 filler metal and the gas metal arc (GMA) welding processes. The J-integral fracture toughness and fatigue crack growth rates of the weldments were measured at 4 K and found to be similar to base metal properties. In a related study, the tensile and notched tensile properties of the same weldments were obtained at room temperature and 4 K. Data for each of the mechanical properties did not vary significantly from weld to weld. It is concluded that the mechanical properties of 5183 at 4 K do not depend on the GMA welding parameters and procedures.

28980 (NBSIR—81-1645, pp 337-355) **Influence of ferrite and nitrogen on mechanical properties of CF8M cast stainless steel.** Finch, L. (ESCO Corp., Portland, OR). Apr 1981. NTIS, PC A99/MF A01.

In Materials studies for magnetic fusion energy applications at low temperatures. IV.

The production and mechanical-property testing of a cast molybdenum stainless steel are described.

28981 (NBSIR—81-1645, pp 357-414) **Metallography of delta-ferrite in austenitic stainless steel castings.** Brown, E.L. (National Bureau of Standards, Boulder, CO). Apr 1981. NTIS, PC A99/MF A01.

In Materials studies for magnetic fusion energy applications at low temperatures. IV.

The volume fraction and morphology of delta-ferrite in austenitic stainless steel castings and welds profoundly influence their mechanical behavior over a wide range of temperatures. A review of the literature summarizes the effects of composition, solidification, and solid state (delta $\rightarrow \gamma$) transformation on the resultant delta-ferrite microstructure in welds and castings. An optical metallographic study was performed on three ASTM A351 Grade CF8M alloy castings (e.g. 18 to 21Cr, 9 to 12Ni, 2 to 3Mo) that possessed different delta-ferrite contents. Metallographic techniques permitted distinction between the solidification and delta $\rightarrow \gamma$ transformation behavior in these castings. All of the alloys solidify in a primary delta mode in which γ precipitates before solidification is complete. The residual delta-ferrite microstructure, owing to the delta $\rightarrow \gamma$ transformation, is generally characterized by curved segments of delta/γ interface connected by straight or faceted segments. Frequently occurring interfacet angles are consistent with the facets being parallel to a [110]delta crystallographic plane and an orientation relationship between delta and γ across the faceted delta/γ interface. The metallographic features of the delta-ferrite microstructure can be rationalized with the aid of a delta $\rightarrow \gamma$ transformation model analogous to that proposed for the proeutectoid $\gamma \rightarrow \alpha$ transformation.

28982 (NBSIR—81-1645, pp 415-451) **Deformation and fracture of stainless steel castings and weldments at 4 K.** Whipple, T.A.; Brown, E.L. (National Bureau of Standards, Boulder, CO). Apr 1981. NTIS, PC A99/MF A01.

In Materials studies for magnetic fusion energy applications at low temperatures. IV.

A number of stainless steel weldments and castings that were deformed at 4 K have been examined with optical and electron microscopy. The purpose of this investigation was to assess qualitatively the effects of residual delta-ferrite on the deformation and fracture mechanisms of these materials at cryogenic temperatures.

28983 (NBSIR—81-1645, pp 453-463) **Evaluation of weld fillers to join nitrogen strengthened stainless steels for cryogenic applications (fusion and MHD energy).** Espy, R.H. (Armco Inc., Middletown, OH). Apr 1981. NTIS, PC A99/MF A01.

In Materials studies for magnetic fusion energy applications at low temperatures. IV.

Tests are reported of austenitic stainless steel weldments that use filler materials manufactured outside the United States.

28984 **(ORNL—5771) Long-term oxidation of selected alloys in superheated steam at 482 and 538°C.** Griess, J.C.; Maxwell, W.A. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 48p. NTIS, PC A03/MF A01. Order Number DE81027068.

The oxidation of several Cr-Mo steels and austenitic materials in superheated steam at 482 and 538°C (900 and 1000°F) is studied. The investigation was conducted in a once-through loop that received steam from the superheater circuit of the Bartow Power Plant of the Florida Power Corporation. This report presents the results from this investigation, which was terminated after 28,339 h when the mode of power plant operation was changed from baseload to peaking.

28985 (ORNL/FMP—81/2, pp 25-39) **New class of steels for thick wall pressure vessels.** Crumley, G.B.; Spencer, P.N.; Todd, J.A.; Parker, E.R. (Univ. of California, Berkeley). Jul 1981. NTIS, PC A17/MF A01.

In AR and TD Fossil Energy Materials Program. Quarterly progress report for the period ending March 31, 1981.

The objective of this program is to develop a new class of steels that can be field-fabricated into large diameter, thick wall pressure vessels for coal gasification/liquefaction systems. In previous work it was found that in some Fe-C-V-Ni alloys a good combination of strength and toughness could be obtained through an isothermal decomposition into ferrite and vanadium carbide. The specific objective in the current program is to develop an Fe-C-V-Ni alloy which exhibits strength and toughness comparable to those of commercially available pressure vessel steels, such as A542 (A387) and A533, through a simple continuous cooling process. The program is divided into four tasks as follows: (1) evaluation of continuous cooling characteristics and optimization of composition; (2) vanadium carbide dissolution and coarsening kinetics; (3) hydrogen attack studies; and (4) weldability studies.

28986 **(ORNL/TM—7810) Ferrite morphology and variations in ferrite content in austenitic stainless steel welds.** David, S.A.; Hanzelka, S.E.; Haltom, C.P. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 36p. NTIS, PC A03/MF A01. Order Number DE81027826.

Four distinct ferrite morphologies have been identified in type 308 stainless steel multipass welds: vermicular, lacy, acicular, and globular. The first three ferrite types are related to transformations following solidification and the fourth is related to the shape instability of the residual ferrite. An earlier study showed that most of the ferrite observed in austenitic stainless steel welds contaning a duplex structure may be identified as residual primary ferrite resulting from incomplete $\delta \rightarrow \gamma$ transformation during solidification and/or residual ferrite after Widmanstaetten austenite precipitation in primary ferrite. These modes of ferrite formation can be used to explain observed ferrite morphologies in austenitic stainless steel welds. Variations in ferrite content within the weld were related to weld metal composition, ferrite morphology, and dissolution of ferrite resulting from thermal cycles during subsequent weld passes. An investigation of the type 308 stainless steel filler metal solidified over cooling rates ranging from 7 to 1600°C/s showed that the cooling rate of the weld metal within the freezing range of the alloy affects the amount of ferrite in the microstructure very litte. However, the scale of the solidification substructure associated with various solidification rates may influence the ferrite dissolution kinetics.

28987 **(RFP—3106) Investigation of americium-241 metal alloys for target applications.** Conner, W.V. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1980. Contract AC04-76DP03533. 49p. (CONF-8010101—4). NTIS, PC A03/MF A01. Order Number DE81026506.

From 9. world conference of the International Nuclear Target Development Society; Gatlinburg, TN, USA (12 Oct 1980).

Several americium-241 metal alloys have been investigated for possible use in the Lawrence Livermore National Laboratory Radiochemical Diagnostic Tracer Program. Alloys investigated have included uranium-americium, aluminum-americium, and cerium-americium. Uranium-americium alloys with the desired properties proved to be difficult to prepare, and work with this alloy was discontinued. Aluminum-americium alloys were much easier to prepare, but the alloy consisted of an aluminum-americium intermetallic compound ($AmAl_4$) in an aluminum matrix. This alloy could be cast and formed into shapes, but the low density of aluminum, and other problems; made the alloy unsuitable for the intended application. Americium metal was found to have a high solid solubility in cerium and alloys prepared from these two elements exhibited all of the properties desired for the tracer program application. Cerium-americium alloys containing up to 34 wt % americium have been prepared using both comelting and coreduction techniques. The latter technique involves coreduction of $Ce F_4$ and AmF_4 with calcium metal in a sealed reduction vessel. Casting techniques have been developed for preparing up to eight 0.87 inch (2.2 cm) diameter disks in a single casting, and cerium-americium metal alloy disks containing from 10 to 25 wt % americium-241 have been prepared using these techniques.

28988 **(SAND—81-0022C) Shock compression of beryllium.** Wise, J.L.; Chhabildas, L.C.; Asay, J.R. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 10p. (CONF-810684—25). NTIS, PC A02/MF A01. Order Number DE81024062.

From APS conference on shock waves in condensed matter; Menlo Park, CA, USA (23 Jun 1981).

Shock/reshock and shock/release experiments have been performed on beryllium to obtain wave profile measurements spanning the stress range of 6 to 35 GPa. Particle velocity histories in the beryllium samples were determined using a velocity interferometer in conjunction with lithium fluoride windows. The shock velocity-particle velocity response of beryllium was obtained from the interferometer signals, which allowed determination of the Hugoniot for Be over the stress range studied.

28989 **(SAND—81-0070C) Analyses of ductile flow and fracture in two dimensions.** Kipp, M.E.; Davison, L. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 8p. (CONF-8106125—1). NTIS, PC A02/MF A01. Order Number DE81023651.

From Shock compression of solids conference; Stanford, CA, USA (23 Jun 1981).

Previous work on analysis of viscoplastic flow and spall fracture by ductile void growth has been extended to configurations of two-dimensional plane strain and axisymmetric deformation. Current work includes reduction of the general theory to a form applicable to these cases, and incorporation of the resulting equations into a Lagrangian finite-difference code suitable for analyzing nonlinear wave propagation. Results of applying this code to study of symmetric axial impact of aluminum bars are presented.

28990 **(SAND—81-1335C) Trapping and surface permeation of deuterium in Fe, Ni, and stainless steel: an ion-beam study.** Myers, S.M. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 20p. (CONF-810913—2). NTIS, PC A02/MF A01. Order Number DE81023303.

From International conference on environmental degradation of engineering materials; Blacksburg, VA, USA (21 Sep 1981).

Ion implantation and ion beam analysis were used to investigate trapping and surface permeability for deuterium (D) in Fe, Ni, and 304 stainless steel. In He-implanted Fe containing $\sim$ 1 nm He bubbles, D was trapped with an enthalpy of 0.75 + - 0.07 eV, referenced to a solution site. The proposed trapping mechanism is chemisorption on the walls of the bubbles. Deuterium was also bound to implantation defects, hypothesized to be vacancies and vacancy clusters, with enthalpies of 0.5 and 0.7 eV respectively. The permeability of the electropolished and air-exposed Fe surface was characterized by a recombination coefficient of K/sub L/ = $10^{-14 +- 0.7}$ mm⁴/s at a temperature of 500 K. Trapping of D was also observed in Ni and 304 stainless steel implanted with He, the measured binding enthalpy being about 0.5 eV in both cases. Bubble traps similar to those observed in Fe are presumed responsible. No surface-barrier effect was detected for Ni, implying K/sub L/ $\geqq 10^{-15}$ mm⁴/s at $\sim$ 350 K. In contrast, for electropolished and air-exposed stainless steel, K/sub L/ $\leqq 10^{-19}$ mm⁴/s at $\sim$ 500 K.

28991 **Slip deformation and melt threshold in laser-pulse-irradiated Al.** Follstaedt, D.M.; Picraux, S.T.; Peercy, P.S.; Wampler, W.R. (Sandia National Laboratories, Albuquerque, New Mexico 87185). DE-AC04-76-DP-789. *Applied Physics Letters ;* **39**: No. 4, 327-329(15 Aug 1981).

We have examined pulse laser-irradiated <110> Al single crystals near the threshold energy for melting by ion channeling

and electron microscopy. We find that slip deformation occurs at incident energies <3.5 J/cm², where melting does not occur for our 20 nsec (full width at half maximum) pulse width, as well as at energies > or ≈3.5J/cm², where a near-surface layer is melted. This slip deformation results in an increase in the channeling minimum yield chi/sub min/, which is attributed to small-angle misalignments between slip planes across the surface. The abrupt increase in chi/sub min/ with melting suggests that channeling can provide a sensitive monitor of the threshold for melting.

28992 **Epitaxial Ge/GaAs heterostructures by scanned cw laser annealing of a-Ge layers on GaAs.** Greene, J.E.; Cadien, K.C.; Lubben, D.; Hawkins, G.A.; Erikson, G.R.; Clarke, J.R. (Departments of Metallurgy, the Coordinated Science Laboratory and the Materials Research Laboratory, University of Illinois, Urbana, Illinois 61810). *Applied Physics Letters ;* **39**: No. 3, 232-234(1 Aug 1981).

Expitaxial Ge/GaAs heterostructures have been produced by scanned cw argon laser annealing of 440-nm-thick amorphous Ge films on (100) semi-insulating GaAs substrates. Depending on the incident laser power and scan rate, two modes of film regrowth were observed. At low powers (between ~1.6 and 4.0 W for a beam diameter of ~40μm) and scan rates between 1 and 400 cm/sec, polycrystalline Ge with a (100) preferred orientation was formed by an "explosive" crystallization mechanism. At higher powers, and over a scan rate range of 20—400 cm/sec, single-crystal films containing some dissolved GaAs in solution were obtained by liquid phase regrowth. Typical film resistivities rho were as follows: as-deposited, rho = 180 Ω cm; polycrystalline films, rho = 3 x 10^{-2} cm; single-crystal films, rho = 9 x 10^{-4}Ω cm.

28993 **Effect of laser annealing on the critical-current density in Nb_3Ge.** Braginski, A.I.; Gavaler, J.R.; Kuznicki, R.C.; Appleton, B.R.; White, C.W. (Westinghouse R&D Center, Pittsburgh, Pennsylvania 15235). DE-AC02-79ET-29354. *Applied Physics Letters ;* **39**: No. 3, 277-279(1 Aug 1981).

Pulse laser annealing of Nb-Ge superconducting films grown by chemical vapor deposition produces an increase in critical-current density, J/sub c/, if the atomic ratio Nb/Ge is less than three. This J/sub c/ increase is caused by flux pinning on the nucleated $Nb_5Ge_3(\sigma)$ second-phase particles rather than on grain boundaries in the melted and resolidified surface layer. This resolidified layer is amorphous or highly disordered.

28994 **Monte Carlo and perturbation-theory calculations for liquid metals.** Ross, M.; DeWitt, H.E.; Hubbard, W.B. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). W-7405-ENG-48. *Physical Review* [*Section*] *A: General Physics ;* **24**: No. 2, 1016-1020(Aug 1981).

Monte Carlo calculations of the thermodynamic properties of a pseudopotential metal fluid, approximating lithium, were carried out over a wide range of temperatures and densities. The calculations were compared with the predictions of variational perturbation theories employing the hard sphere, soft sphere, and the one component plasma (OCP) as reference systems. The OCP predictions are in better agreement with Monte Carlo pressures, but are comparable for energies. The OCP reference system has the lower Helmholtz free energy at all points studied.

28995 **Pauli limiting and the possibility of spin fluctuations in the A15 superconductors.** Orlando, T.P.; Beasley, M.R. (Stanford University, Stanford, California 94305). *Physical Review Letters ;* **46**: No. 24, 1598-1601(15 Jun 1981).

From the critical field data on the strongly Pauli limited superconductor V_3Ga it is shown that large electron-electron interactions (and their associated spin fluctuations) may play an important role in the superconductivity of the A15 superconductors. This possibility is shown to be consistent with existing T/sub c/, heat capacity, and spin susceptibility data on several A15 superconductors.

28996 **Critical exponents of a four-state Potts chemisorbed overlayer: p(2 x 2) oxygen on Ni(111).** Roelofs, L.D.; Kortan, A.R.; Einstein, T.L.; Park, R.L. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). DE-AS05-79ER-10427. *Physical Review Letters ;* **46**: No. 22, 1465-1468(1 Jun 1981).

We report the first determination of critical exponents for a chemisorbed overlayer, using low-energy electron diffraction. We examine the order-disorder transition of p(2 x 2) oxygen on the (111) surface of nickel. This study is the first of critical behavior of a two-dimensional system in the four-state Potts universality class. From measured diffraction beam profiles, we extract the exponents β, γ, and ν. Discussion of disparity between our results and predicted exponents considers several possibilities, including logarithmic corrections.

28997 **Electron-energy-loss spectroscopy and oxygen overlayers on the Ni(100) surface.** Rahman, T.S.; Black, J.E.; Mills, D.L. (Department of Physics, University of California, Irvine, California 92717). DE-AT0379-ER10432. *Physical Review Letters ;* **46**: No. 22, 1469-1472(1 Jun 1981).

We present an analysis of the electron-energy-loss spectra produced by dipole scattering from lattice vibrations of the p(2 x 2) and c(2 x 2) oxygen overlayer on the Ni(100) surface. We conclude that the distance between the oxygen layer and the Ni surface is very much smaller for the c(2 x 2) overlayer than for the p(2 x 2), in accord with a recent suggestion by Upton and Goddard.

28998 **Nickel colloids in reduced nickel-doped magnesium oxide.** Narayan, J.; Chen, Y.; Moon, R.M. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Physical Review Letters ;* **46**: No. 22, 1491-1494(1 Jun 1981).

High-temperature treatment in a reducing atmosphere of Ni-doped MgO crystals resulted in the formation of colloids with an average size of about 50 nm. Electron microscope studies on these precipitates established that they are coherent nickel precipitates having a fcc structure with a lattice constant of 0.352 nm, and occasionally a bcc structure with a lattice constant of 0.288 nm. The ratio of magnetic to nuclear scattering amplitudes for the (111) precipitate reflection was about 17% below the value for nickel. Optical absorption measurements indicate that a broad optical band centered at ~2.2 eV is associated with the colloidal precipitates.

28999 **Comparative study of the thermodynamics of superconducting Nb/sub 0.75/Zr/sub 0.25/ and Nb.** Mitrovic, M.; Carbotte, J.P. (Physics Department, McMaster University, Hamilton, Ontario, Canada). *Journal of Low Temperature Physics ;* **43**: No. 1, 131-163(1 Apr 1981).

From the mircoscopic parameters derived from tunneling for Nb/sub 0.75/Zr/sub 0.25/ and Nb we compute and compare their thermodynamic properties using the imaginary frequency axis formulation of Eliashberg theory. While these two materials have similar critical temperatures, Nb/sub 0.75/Zr/sub 0.25/ is found to show much larger strong coupling corrections than does Nb. The substantial increase in the gap to critical temperature ratio observed experimentally can easily be understood by functional derivative techniques.

29000 **Investigations of electric dipole fields in type II superconductors during flux flow.** Mueller, B.; Heiden, C.; Li, P.S.; Clem, J.R. (Institut fuer Angewandte Physik der Universitaet Giessen, Giessen, West Germany). W-7405-ENG-82. *Journal of Low Temperature Physics ;* **43**: No. 1, 165-187(1 Apr 1981).

Electric dipole fields in the mixed state of rectangular superconducting foils are investigated both theoretically and experimentally. These fields are generated by imposing an ac current to a contact pair during steady flux flow driven by a transport current and are measured using a second, movable contact pair. Theory predicts that the electric dipole field can be described by an anisotropic flux flow conductivity, whose components σ/sub x/ and σ/sub y/ are related by σ/sub x//σ/sub y/ = 1-(j/sub c//j/sub parallel/)$\cos^2 \gamma$, where j/sub parallel/ is the dc current density j/sub c/ is the dynamic critical current density, and γ is the field angle.

Except for low j/sub parallel/ values at the threshold of flux flow, good agreement with experiment is found.

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 28199, 28274, 28837, 28839, 29008, 29192, 29699

29001 (ANL-CEN-RSD—81-2) Enthalpy and heat capacity of solid UO_2. Fink, J.K.; Chasanov, M.G.; Leibowitz, L. (Argonne National Lab., IL (USA)). May 1981. Contract W-31-109-ENG-38. 15p. NTIS, PC A02/MF A01. Order Number DE81027565.

Equations have been derived based upon a reevaluation of the enthalpy and heat-capacity data of UO_2. We recommend a three-term nonlinear equation below 2670 K, with terms representing contributions from phonons, volumetric thermal expansion, and electrons, and a linear equation above 2670 K.

29002 (ANL-CEN-RSD—81-3) Thermal conductivity and thermal diffusivity of solid UO_2. Fink, J.K.; Chasanov, M.G.; Leibowitz, L. (Argonne National Lab., IL (USA)). Jun 1981. Contract W-31-109-ENG-38. 23p. NTIS, PC A02/MF A01. Order Number DE81027566.

New equations for the thermal conductivity of solid UO_2 were derived based upon a nonlinear least squares fit of the data available in the literature. In the development of these equations, consideration was given to their thermodynamic consistency with heat capacity and density and theoretical consistency with enthalpy and heat capacity. Consistent with our previous treatment of enthalpy and heat capacity, 2670 K was selected as the temperature of a phase transition. A nonlinear equation, whose terms represent contributions due to phonons and electrons, was selected for the temperature region below 2670 K. Above 2670 K, the data were fit by a linear equation.

29003 (CONF-810705—4) Quantification of energy-loss measurements with the use of K and L absorption edges. Sklad, P.S.; Bentley, J.; Lehman, G.L. (Oak Ridge National Lab., TN (USA); Oak Ridge Associated Universities, Inc., TN (USA)). 1981. Contract W-7405-ENG-26. 7p. NTIS, PC A02/MF A01. Order Number DE81027134.

From 16. annual conference of the Microbeam Analysis Society; Vail, CO, USA (13 Jul 1981).

Quantitative analysis of electron energy loss measurements has received increasing attention in recent years. Most of the results reported, however, rely on the analysis of integrated intensities from K ionization edges from light elements. Results reported using L edges have mostly involved qualitative comparisons. There have been a few exceptions. The inclusion of cross sections from L edges in various quantification programs has made possible analysis of a wide range of engineering materials. One such program has been used at ORNL to perform quantitative analyses on the ceramic materials TiB_2 and Si_3N_4. The results of these analyses suggest that when K and L edges are used together the data are consistently less accurate than when K edges alone are used.

29004 (DOE/ER/02390—T1) Basic research in crystalline and noncrystalline ceramic systems. Annual report, August 1, 1980-October 31, 1981. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). 1981. Contract AS02-76ER02390. 72p. NTIS, PC A04/MF A01. Order Number DE81027867.

The Basic Research Programs in Ceramics sponsored by the US Department of Energy supports a significant fraction of the research effort and graduate student training in ceramics at MIT. Various research activities involving ceramic materials include electrical properties; kinetic studies; defect structures, defect interactions, grain boundaries and surfaces; sintering studies; and mechanical properties.

29005 (GA-A—16005) Low-activation-materials safety studies. Annual report for fiscal year 1980, January 1-September 30, 1980. (General Atomic Co., San Diego, CA (USA)). Dec 1980. Contract AT03-76SF70046. 145p. NTIS, PC A07/MF A01. Order Number DE81027623.

A study program has been conducted for EG and G Idaho, Inc., National Engineering Laboratory (INEL) by General Atomic Company on the safety implications of utilizing low activation ceramic materials in fusion power reactor systems. This annual report gives the results of the first year's study. Three major areas are covered, radioactivity analyses, ceramics engineering, and the development of a program plan for application of the low activation ceramic materials. The radioactivity analyses show that afterheat effects in fusion reactors can be virtually completely eliminated with some ceramic materials. The biological hazards from storage and waste disposal, and the biological dose rates for maintenance and repair operations are almost entirely due to impurities in the materials. The program development plan focuses on component development with a continuing systems studies program to pace the fusion reactor development schedule.

29006 (IS-M—331) Specific heat of LuH/sub x/ below 2 K. Gschneidner, K.A. Jr.; Gnugesser, H.; Neumaier, K. (Ames Lab., IA (USA); Bayerische Akademie der Wissenschaften, Garching (Germany, F.R.). Zentralinstitut fuer Tieftemperaturforschung). 1981. Contract W-7405-ENG-82. 2p. (CONF-810809—13). NTIS, PC A02/MF A01. Order Number DE81025451.

From 16. international conference on low temperature physics; Los Angeles, CA, USA (19 Aug 1981).

Specific heat measurements on LuH/sub x/ ($0.001 \leqq x \leqq 0.014$) revealed a large anomaly above 0.1 K, which is thought to be due to H-tunneling. The results indicate tunneling energies of about 1 K and suggest the presence of strain induced interaction effects between different tunneling H-atoms. It is proposed that the H-atoms in Lu occupy a system of off center tunneling positions in interstitial octahedral sites.

29007 (UCRL—85274) Microstructure of explosively compacted aluminum nitride ceramic. Gourdin, W.H.; Echer, C.J.; Cline, C.F.; Tanner, L.E. (Lawrence Livermore National Lab., CA (USA); Lawrence Berkeley Lab., CA (USA)). 1 May 1981. Contract W-7405-ENG-48. 12p. (CONF-810910—1). NTIS, PC A02/MF A01.

From 7. international conference on high energy rate fabrication; Leeds, UK (15 Sep 1981).

Observations are reported of the microstructure of aluminum nitride (A1N) ceramic produced by explosive consolidation of the powder. Similarities between the grain structure of the compact and the starting powders are striking. Grain growth does not occur during densification and the 0.1 μ particle size of the powder is retained, although considerable deformation is introduced into individual grains. Of particular interest is an intergranular phase which appears throughout the compact. Observations in the transmission electron microscope indicate that this phase is amorphous.The influence of this glassy intergranular phase on bonding is discussed. 5 figures.

3603 Composite Materials

REFER ALSO TO CITATION(S) 28057, 28741, 28741

29008 (NBSIR—81-1645, pp 467-473) Nonmetallics for magnet systems. Kasen, M.B. (National Bureau of Standards, Boulder, CO). Apr 1981. NTIS, PC A99/MF A01.

In Materials studies for magnetic fusion energy applications at low temperatures. IV.

An introduction to the nonmetallics program is presented. Topics discussed are: standard grades, radiation resistance, materials characterization, and technology transfer. Plans for FY 81 are presented.

29009 (NBSIR—81-1645, pp 477-492) Standardizing nonmetallic composite materials for cryogenic applications. Kasen, M.B. (National Bureau of Standards, Boulder, CO). Apr 1981. NTIS, PC A99/MF A01.

In Materials studies for magnetic fusion energy applications at low temperatures. IV.

The designer of superconducting magnet systems is confronted with a difficult task in specifying the nonmetallic insulating and structural support materials required for proper system func-

tioning. He finds it necessary to select from a profusion of products identified by trade names, most of which were developed for other than cryogenic use and for which reliable cryogenic performance data are nonexistent. This paper describes the ongoing efforts by NBS and industry to provide a commercial supply of standardized cryogenic grades of the most widely used insulating laminates having well-characterized cryogenic performance. These laminates will also provide the basis for a systematic materials development program in response to user needs. The elements required for a more generalized laminate coding system incorporating all materials of interest to magnet designers are also considered.

29010 (NBSIR—81-1645, pp 495-506) **Thermal conductivity of G-10CR and G-11CR industrial laminates at low temperatures (Part III).** Hust, J.G.; Boscardin, R. (National Bureau of Standards, Boulder, CO). Apr 1981. NTIS, PC A99/MF A01.

In Materials studies for magnetic fusion energy applications at low temperatures. IV.

Thermal conductivity measurements from 2 to 300 K were made on the resins used in two cryogenic grades of fiberglass/epoxy composites, G-10CR and G-11CR. Effects of specimen thickness and inhomogeneity of the bulk sample were studied. Also, the thermal conductivity of a European glass-fiber/epoxy composite was measured to assess the variation between measurements at CERN and at NBS. The accuracy of the NBS measurements was checked by measurements on a standard reference material.

29011 (NBSIR—81-1645, pp 507-587) **Fracture analysis of compression damage in glass fabric/epoxy, G-10CR, 295 K to 4 K.** Beck, B.A. (National Bureau of Standards, Boulder, CO). Apr 1981. NTIS, PC A99/MF A01.

In Materials studies for magnetic fusion energy applications at low temperatures. IV.

This report describes scanning electron and optical microscope fractographic and modeling studies of G-10CR compression fracture at room and cryogenic temperatures. Results of the fractography have shown that the failure events included three kinds of primary fracture patterns which, to varying degrees, are temperature-related. These fractures have been identified as: (1) a 55° slant mode; (2) a chisel or V-notch mode; and (3) a complex or mixed mode. The influence of constituent properties and behavior have been integral considerations in assessing the fracture mechanism and in analytical interpretations of the fracture behavior. As in other materials, the damage zone in these composites is the result of either discrete or interactive constituent failure processes (or both) occurring in a highly strained region of the specimen. Fiber microcracking or fracture, matrix yielding or cracking, and interface failure are examples of such events. Nucleation and propagation of fracture, as in other fiber-reinforced composites, is a function of microstructure, microdeformation, and the structural interaction of the constituents. Compressive strength data variability has been graphically correlated with primary and secondary fracture characteristics in order to understand the low temperature effects better.

29012 (NBSIR—81-1645, pp 589-595) **Static and dynamic Young's moduli of two fiber-reinforced composites.** Ledbetter, H.M. (National Bureau of Standards, Boulder, CO). Apr 1981. NTIS, PC A99/MF A01.

In Materials studies for magnetic fusion energy applications at low temperatures. IV.

Two uniaxially fiber-reinforced composites were studied: graphite/epoxy and E-glass/epoxy. Dynamic Young's modulus was determined at kHz frequencies using a Marx three-component oscillator. Comparison with the static Young's modulus determined in compression shows agreement within experimental error.

29013 (NBSIR—81-1645, pp 597-602) **Radiation effects on composites and nonmetallic materials.** Kasen, M.B. (National Bureau of Standards, Boulder, CO). Apr 1981. NTIS, PC A99/MF A01.

In Materials studies for magnetic fusion energy applications at low temperatures. IV.

This discussion of radiation effects is part of a review paper on composites. The other parts of the review appeared last year, in Volume III of this series.

29014 (NBSIR—81-1645, pp 613-638) **Manufacture of radiation resistant laminates.** Benzinger, J.R. (Spaulding Fibre Co., Inc., Tonawanda, NY). Apr 1981. NTIS, PC A99/MF A01.

In Materials studies for magnetic fusion energy applications at low temperatures. IV.

Mechanical strength testing of some of the experimental G-10CR variants designed for improved radiation resistance yielded some surprising results. Also to be reviewed are the design rationale, materials of construction, and method of manufacture of some polyimide and epoxy laminates prepared for MIT and ORNL irradiation effect studies. Cost comparisons, availability and anticipated manufacturing problems associated with some raw materials and laminates will be discussed.

3604 Polymers And Plastics

29015 **(DOE/ER/10655—1) Polymers in mechanochemical systems: structure-property requirements. Progress report, June 1, 1980-May 31, 1981.** Mandelkern, L. (Florida State Univ., Tallahassee (USA)). 1981. Contract AS05-80ER10655. 10p. NTIS, PC A02/MF A01. Order Number DE81026345.

This initial phase of the contract period has been devoted to the preparation of a cis-polyisoprene sample for crystallization studies; design and construction of instrumentation to carry out investigations of crystallization kinetics and melting under uniaxial and biaxial deformation, as well as preliminary studies of mechanical properties of polyethylene with controlled supermolecular structures. We report the details of the instrument design, the demonstration that reproducible results can be obtained for both types of deformation and early findings which indicate the direction of more detailed studies. The initial studies of the mechanical properties have established the conditions necessary to obtain reproducible results; the fact that the supermolecular structures exert an influence and the other structural and morphological variables that will be of importance.

29016 **Combined environment aging effects: radiation-thermal degradation of polyvinylchloride and polyethylene.** Clough, R.L.; Gillen, K.T. (Sandia National Labs., Albuquerque, NM). *Journal of Polymer Science, Polymer Chemistry Edition ;* **19**: No. 8, 2041-2051(Aug 1981).

Results are presented for a case of polymer aging in which powerful synergisms are found between radiation and temperature. This effect was observed with formulations of polyvinylchloride and polyethylene and occurred in simultaneous and sequential radiation-thermal experiments. Dose rate dependencies, which appear to be mechanistically related to the synergism, were also found. The evidence indicates that these aging effects are mediated by a thermally induced breakdown of peroxides initially formed by the radiation. Similar effects could be important to material degradation in a variety of other types of combined-stress environment. A new technique, which uses PH_3 treatment of intact polymer specimens to test for the importance of peroxides in the pathway that leads to changes in macroscopic tensile properties, is described.

3606 Other Materials

REFER ALSO TO CITATION(S) 28245, 28274, 28277, 28278, 28290, 28650, 28650, 28656, 28656, 29144, 29372, 29416, 29566, 29567

29017 **(BNL—29725) Mobile ion distribution and anharmonic thermal motion in fast ion conducting Cu_2S.** Cava, R.J.; Reidinger, F.; Wuensch, B.J. (Brookhaven National Lab., Upton, NY (USA); Bell Labs., Murray Hill, NJ (USA); Massachusetts Inst. of Tech., Cambridge (USA)). 1981. Contract AC02-76CH00016. 4p. (CONF-810566—5). NTIS, PC A02/MF A01. Order Number DE81026050.

From International conference on fast ionic transport in solids; Gatlinburg, TN, USA (18 May 1981).

A unique model was determined for the mobile copper ion disorder in hexagonal Cu_2S between 120° and 325°C via single crystal neutron diffraction. The copper ions partially occupy two sets of three-coordinated sites within the HCP sulfur array and dis-

play anharmonic thermal motion. The results suggest that the conductivity is two dimensional in nature.

29018 **(DOE/ER/01198—1359) High-pressure optical studies.** Drickamer, H.G. (Illinois Univ., Urbana (USA). School of Chemical Sciences). 1981. Contract AC02-76ER01198. 11p. (CONF-810828—1). NTIS, PC A02/MF A01. Order Number DE81025577.

From Conference on high pressure physics; Bad Honnef, F.R. Germany (Aug 1981).

High pressure experimentation may concern intrinsically high pressure phenomena, or it may be used to gain a better understanding of states or processes at one atmosphere. The latter application is probably more prevelant in condensed matter physics. Under this second rubric one may either use high pressure to perturb various electronic energy levels and from this pressure tuning characterize states or processes, or one can use pressure to change a macroscopic parameter in a controlled way, then measure the effect on some molecular property. In this paper, the pressure tuning aspect is emphasized, with a lesser discussion of macroscopic - molecular relationships. In rare earth chelates the efficiency of 4f-4f emission of the rare earth is controlled by the feeding from the singlet and triplet levels of the organic ligand. These ligand levels can be strongly shifted by pressure. A study of the effect of pressure on the emission efficiency permits one to understand the effect of ligand modification at one atmosphere. Photochromic crystals change color upon irradiation due to occupation of a metastable ground state. In thermochromic crystals, raising the temperature accomplishes the same results. For a group of molecular crystals (anils) at high pressure, the metastable state can be occupied at room temperature. The relative displacement of the energy levels at high pressure also inhibits the optical process. Effects on luminescence intensity are shown to be consistent. In the area of microscopic - molecular relationships, the effect of viscosity and dielectric properties on rates of non-radiative (thermal) and radiative emission, and on peak energy for luminescence is demonstrated. For systems which can emit from either of two excited states depending on the interaction with the environment, the effect of rigidity of the medium on the rate of rearrangement of the excited state is shown.

29019 **Monitoring UF_6 photodissociation via laser multiphoton ionization.** Stuke, M.; Reisler, H.; Wittig, C. (Departments of Electrical Engineering, Physics, and Chemistry, University of Southern California, Los Angeles, California 90007). *Applied Physics Letters ;* **39**: No. 3, 201-203(1 Aug 1981).

Laser multiphoton ionization (MPI) is used to detect nascent photoproducts following the UV photodissociation of UF_6. Sensitivity is high, and there is no measurable background due to the MPI of parent UF_6. The technique is very well suited for monitoring isotopically selective photodissociation on a "single shot" basis.

29020 **(LBL—12849) Pre eutectic densification in MgF_2 - CaF_2.** Hu, S.C. (Lawrence Berkeley Lab., CA (USA)). May 1981. Contract W-7405-ENG-48. 94p. NTIS, PC A05/MF A01. Order Number DE81027553.

Thesis.

Three sintering methods were used: (a) Arrested zone sintering, (b) constant heating rate sintering, and (c) constant temperature sintering. Microstructural evolution and shrinkage vs temperature behaviour were studied. It was found that the sintering rate of MgF_2 was enhanced by CaF_2 eutectic additive, and that the enhancement of sintering started at about 200°C below the eutectic temperature. The effectness of CaF_2 saturates at about 1 wt%. By comparing the diffusivities obtained from diffusion experiment and constant temperature sintering experiment, it is concluded that the enhanced pre-eutectic densification kinetics result from increased solid state grain boundary transport due to eutectic forming phase. The possible effect of oxidation on the eutectic temperature of CaF_2 - MgF_2 during the experiment has been verified to strengthen the conclusion that solid state mass transport causes the enhancement. Auger analysis shows that Ca^{+2} is enriched at grain boundaries in a layer with a thickness of about 100 A. 28 figures, 9 tables.

29021 **(SAND—81-0128C) Theory of NMR relaxation by paramagnetic impurities in a quasi-one-dimensional fast-ion conductor.** Richards, P.M. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 6p. (CONF-810566—6). NTIS, PC A02/MF A01. Order Number DE81027100.

From International conference on fast ionic transport in solids; Gatlinburg, TN, USA (18 May 1981).

The NMR relaxation rate of diffusing nuclei interacting with paramagnetic impurities is treated in a quasi 1D system. The rate is proportional to c for low impurity concentration c, rather than to c^2, the result for pure 1D. Comparison is made with data on iron-doped β-eucryptite (β-$LiAlSiO_4$).

29022 **(UCRL—85776) Stochastic theory of scattering from idealized spinodal structures I: Structure and autocorrelation function.** Hopper, R.W. (Lawrence Livermore National Lab., CA (USA)). 20 Jul 1981. Contract W-7405-ENG-48. 33p. (CONF-810736—2). NTIS, PC A03/MF A01. Order Number DE81026529.

From Meeting on glass structures: surface and bulk; University Park, PA, USA (28 Jul 1981).

In the early stage (ES) of spinodal decomposition, composition fluctuations in a nominally homogeneous glass are selectively amplified over a narrow range of wavelengths. As their amplitude increases, nonlinear coupling slows further amplitude growth, coarsens the structure, sharpens the interfaces, and adjusts the phase compositions and volume fractions toward their equilibrium values; but the morphology of the late stage (LS) structure is dominated by the ES morphology. It is widely believed that the LS morphology can be modelled as the positive and negative composition deviations from the average, that are obtained from a superposition of waves of fixed wavelength LAMBDA but of random orientation and phase. Here, LAMBDA is not identified with the dominant ES wavelength. This LS model, and modifications of it, are analyzed using stochastic theory. The autocorrelation function of the model is determined using methods developed for the analysis of electrical random noise signals that have passed through a nonlinear amplifier.

29023 **(UCRL—86513) Polishing-to-figuring transition in turned optics.** Brown, N.J.; Baker, P.C.; Parks, R.E. (Lawrence Livermore National Lab., CA (USA); Arizona Univ., Tucson (USA). Optical Sciences Center). 29 Jul 1981. Contract W-7405-ENG-48. 8p. (CONF-810810—14). NTIS, PC A02/MF A01. Order Number DE81028691.

From SPIE international symposium; San Diego, CA, USA (24 Aug 1981).

The spatial frequency response of elastic backed flexible lapping belts is examined. The transition from planing off to propagating sinusoidal ripple is shown to be extremely sensitive to ripple frequency.

29024 **Recovery of range-zone luminescence by pulsed laser annealing in Cd^+-implanted GaAs.** Norris, C.B.; Peercy, P.S. (Sandia National Laboratory, Albuquerque, New Mexico 87185). DE-AC04-76DP00789. *Applied Physics Letters ;* **39**: No. 4, 351-353(15 Aug 1981).

The effects of 300-K implantation of 200-keV Cd^+ ions and subsequent pulsed laser annealing in GaAs were investigated by means of depth-resolved cathodoluminescence at 80 K. We found that lattice order could be restored sufficiently to increase the implanation-quenched luminescence by 2—3 orders of magnitude with either ruby or Nd:glass lasers. Thus the luminescence is recovered to within an order of magnitude of that in unimplanted material.

29025 **Electron spin echo study of Nd^{3+} solvation in methanol glasses.** Janakiraman, R.; Kevan, L. (Department of Chemistry, University of Houston, Houston, Texas 77004). *Journal of Chemical Physics ;* **75**: No. 4, 1658-1660(15 Aug 1981).

Electron spin echo modulation studies have been carried out for Nd^{3+} in methanol glasses at 4.2 K. By using the partially deuterated methanols (CH_3OD and CD_3OH), analysis of deuterium modulation in three-pulse electron spin echo decay curves gives the distances and numbers of Nd—D(OD) and Nd—D(CD_3) interactions.

It is found that Nd^{3+} is coordinated by nine equivalent methanol molecules, with distances of Nd—H (OH) of 3.1 A and Nd—H (CH_3) of 4.0 A. These distances establish that the molecular dipole of methanol is oriented toward Nd^{3+}.

29026 **Pseudogap state density in sputtered a-Si:H from field effect and capacitance measurements.** Weisfield, R.; Viktorovitch, P.; Anderson, D.A.; Paul, W. (Division of Applied Sciences, Harvard University, Cambridge, Massachusetts 02138). EF-77-C-01-4042;XW-0-9358-1. *Applied Physics Letters ;* **39**: No. 3, 263-265(1 Aug 1981).

Changes in film deposition procedure have permitted us to measure, for the first time, field-effect-induced current multiplication up to 10^4 in sputtered a-Si:H. The deduced Fermi-level state density of the order of 1×10^{17} eV^{-1} cm^{-3} agrees within small errors with analysis of capacitance measurements on codeposited samples.

29027 **Infrared and Raman studies of pressure effects on the vibrational modes of solid CO_2.** Hanson, R.C.; Jones, L.H. (Physics Department, Arizona State University, Tempe, Arizona 85281). *Journal of Chemical Physics ;* **75**: No. 3, 1102-1112(1 Aug 1981).

Infrared and Raman studies have been made on the librational and internal modes of solid CO_2 in the pressure range of 6 to 120 kbar at ambient temperature. The Fermi resonance has been analyzed in detail. Both of the stretching modes stiffen with pressure while the bending mode softens with pressure. The magnitude of the Fermi interaction parameter W decreases somewhat with pressure. A simple model using gas phase anharmonic constants predicts much of the observed behavior.

29028 **Temperature dependence of the triplet exciton yield in fission and fusion in tetracene.** Arnold, S.; Whitten, W.B. (Department of Physics, Polytechnic Institute of New York, Brooklyn, New York 11201). *Journal of Chemical Physics ;* **75**: No. 3, 1166-1169(1 Aug 1981).

The increase in quantum efficiency for luminescence with increasing excitation intensity is measured as a function of temperature in tetracene. The results indicate that the quantum efficiency for the production of triplets from an excited singlets decreases markedly below 300 °K. This decrease is accounted for by a process which competes with exciton fission with a rate $K = (1.3 +- 0.2) \times 10^8$ sec^{-1}. This value is shown to be inconsistent with a singlet trapping interpretation for the nonexponential decays found by others in the prompt fluorescence. The results are consistent with a nearly temperature independent value for the fraction of exciton fusion events which lead to excited singlets f. The relative constancy of f above 300 °K implies that fusion resulting in a triplet proceeds via the first excited triplet. This in turn provides a qualitative explanation for the apparent lack of a relationship between the measured value of f and the rudimentary value inferred from spin statistics.

29029 **Neutron-diffraction studies of Tb_2C and Dy_2C in the temperature range 4—296 K.** Atoji, M. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics ;* **75**: No. 3, 1434-1441(1 Aug 1981).

Neutron power-diffraction data of the trigonal Tb_2C have been obtained and compared with our previous results (given in parentheses) for a Tb-rich Tb_2C. Significant differences were observed in the c spacing and the ferromagnetic moment, e.g., the saturation value of 7.6(8.6) Bohr magnetons, which is 84(96)% of the free-ion moment, indicating a considerable crystal-field effect. The Curie temperature (266 K) and an unusual magnetostriction along c were unchanged. The ordered-moment direction (parallel to c) has now been established unambiguously using a magnetically induced, preferential crystallite orientation in Tb_2C. A short-range ferromagnetic ordering, which coexists with the long-range ordering in Tb_2C, was analyzed anew. Dy_2C becomes ferromagnetic below 168 K, and the saturation ordered moment is 6.8 Bohr magnetons, which is 68% of the free-ion moment. A magnetically induced, preferential crystallite orientation in Dy_2C indicated that the ordered-moment direction is parallel to the [104] axis, which corresponds to the [100] axis of the high-temperature cubic modification.

29030 **Photoelectron spectrum of Xe_3 by the photoelectron—photoion coincidence technique.** Poliakoff, E.D.; Dehmer, P.M.; Dehmer, J.L.; Stockbauer, R. (Argonne National Laboratory, Argonne, Illinois 60439). W-31-109-ENG-38. *Journal of Chemical Physics ;* **75**: No. 3, 1568-1569(1 Aug 1981).

The technique of photoelectron—photoion coincidence spectroscopy is used to obtain the photoelectron spectrum of the Xe_3 trimer in the energy region of the first ionization potential. The results show that the first vertical ionization potential of Xe_3 is 11.47(9) eV versus 11.85 eV in Xe_2. This experiment demonstrates for the first time the feasibility of obtaining a photoelectron spectrum of a cluster contained in a mixture of n-mers. This measurement yields insight into the electronic structure changes occurring as free atoms combine to form solids and will provide additional information as the studies are extended to higher n-mers.

29031 **Application of differential anomalous x-ray scattering to structural studies of amorphous materials.** Fuoss, P.H.; Eisenberger, P.; Warburton, W.K.; Bienenstock, A. (Bell Laboratories, Murray Hill, New Jersey 07974). DMR-77-27489. *Physical Review Letters ;* **46**: No. 23, 1537-1540(8 Jun 1981).

A differential anomalous x-ray scattering technique has been developed for structural studies of disordered and amorphous systems. The results on amorphous $GeSe_2$ are consistent with the twofold coordination of Se and the fourfold coordination of Ge. The results on amorphous GeSe are consistent with threefold coordinated models of the structure but not with the fourfold-twofold models.

29032 **Elastic wave scattering by a flaw in an isotropic, homogeneous solid.** Baker, G.A. Jr.; Gammel, J.L. (Theoretical Division, University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). W-7405-ENG. 36. *Journal of Applied Physics ;* **52**: No. 6, 3729-3737(Jun 1981).

In a framework where a flaw is regarded as the spatial variation of the density and the elastic constants of the host medium, we derive a matrix scattering formalism. We introduce a bivariational principle for the scattering amplitude and use it to develop an optimal-type approximation scheme. We consider the implications of reflection-plane symmetry and show that when the incident and scattered waves lie in this plane, certain polarized, scattering amplitudes are zero. We develop a "partial-wave" expansion for any flaw of spherical symmetry and reduce this scattering problem to a feasible numerical computation.

29033 **Grain boundary recombination: Theory and experiment in silicon.** Seager, C.H. (Sandia National Laboratories, Albuquerque, New Mexico 87185). DE-AC04-76-DP00789. *Journal of Applied Physics ;* **52**: No. 6, 3960-3968(Jun 1981).

Calculations have been made of the barrier heights and recombination velocities at semiconductor grain boundaries subject to uniform illumination with above-band-gap light. A detailed balance approach has been coupled with a solution of the current continuity equation to yield a full solution of the problem subject to the approximation that majority carrier currents can be properly described by thermionic emission expressions. Silicon bicrystal data are presented and shown to be in good agreement with the predictions of the theory.

29034 **Trapping of Sb by TaC and Cu precipitates in ion-implanted Fe.** Myers, S.M.; Follstaedt, D.M. (Sandia National Laboratories, Albuquerque, New Mexico 87185). DE-AC04-76-DP00789. *Journal of Applied Physics ;* **52**: No. 6, 4007-4017(Jun 1981).

Experimental evidence is presented for trapping of Sb by TaC and Cu precipitates in Fe. These processes were studied during annealing at 873 K of Fe ion-implanted with either Ta, C, and Sb, or Cu and Sb. For both precipitates the derived binding enthalpy is ~0.4 eV when referenced to an Sb solution site in the bcc-Fe phase. It is argued that this trapping occurs at the precipitate-host interface, and that it is due primarily to the associated structural discontinuity. In the Fe-Cu-Sb alloys, trapping was accompanied by two other processes which immobilize Sb, namely,

dissolution into the fcc-Cu phase and formation of β-Cu_3Sb. The trapping effects observed in these studies are of potential significance for the control of Sb embrittlement in ferritic steels.

29035 Ion implantation and low-temperature epitaxial regrowth of GaAs. Grimaldi, M.G.; Paine, B.M.; Nicolet, M.; Sadana, D.K. (California Institute of Technology, Pasadena, California 91125). *Journal of Applied Physics ;* **52**: No. 6, 4038-4046(Jun 1981).

Channeling and transmission electron microscopy have been used to investigate the parameters that govern the extent of damage in ion-implanted GaAs and the crystal quality following capless furnace annealing at low temperature (~400 °C). The implantation-induced disorder showed a strong dependence on the implanted ion mass and on the substrate temperature during implantation. When the implantation produced a fully amorphous surface layer the main parameter governing the regrowth was the amorphous thickness. Formation of microtwins after annealing was observed when the initial amorphous layer was thicker than 400 A. Also, the number of extended residual defects after annealing increased linearly with the initial amorphous thickness and extrapolation of that curve predicts good regrowth of very thin (<400 A) GaAs amorphous layers produced by ion implantation. A model is presented to explain the observed features of the low-temperature annealing of GaAs.

29036 Oxygen-sensitive electrode impedance in Sr-doped $LaCrO_3$. Bethin, J.; Chiang, C.K.; Franklin, A.D.; Snellgrove, R.A. (National Bureau of Standards, Washington, D. C. 20234). *Journal of Applied Physics ;* **52**: No. 6, 4115-4117(Jun 1981).

Barrier layers are apparently formed on Sr-doped $LaCrO_3$ that give rise to an appreciable electrode impedance with electrodes of Au or Pt. The corresponding electrode resistance is quite sensitive to the oxygen activity in the atmosphere, following atmospheric changes at temperatures near room temperature with time constants of the order of minutes or days. The electrical properties of these barrier layers at room temperature do not conform to the models of simple Schottky layers on semiconductors, but exhibit a pattern of changing oxidation states at the interface region.

29037 Conduction mechanisms and 1/f noise in thick-film resistors with $Pb_3Rh_7O_{15}$ and $Pb_2Ru_2O_7$. de Jeu, W.H.; Geuskens, R.W.J.; Pike, G.E. (Philips Reasearch Laboratories, Eindhoven, The Netherlands,). DE-AC04-76-DP00789. *Journal of Applied Physics ;* **52**: No. 6, 4128-4134(Jun 1981).

Thick-film resistors with $Pb_3Rh_7O_{15}$ and $Pb_2Ru_2O_7$ as conductors are considered. These compounds are chemically stable during the firing process of the resistors. The variation of sheet resistivity R/sub D'Alembertian/ with volume fraction conductor follows a simple power law. This result cannot be explained by percolation theory in its simple form. The conductivity is found to be independent of frequency up to 10 GHz. In both cases a small positive Hall coefficient is observed which is interpreted as being due to mixed electron and hole conduction. Finally the 1/f noise is considered, and is found to vary approximately linearly with R/sub D'Alembertian/. A theoretical model for the 1/f noise in thick-film resistors is presented that accounts for this linear relationship. The observed deviations from linearity indicate that probably tunneling through barriers at the interfaces between the conducting grains is an important factor in determining the conduction.

29038 Dynamic effects of a thin metal plate during pulse heating and expansion into the liquid-vapor region. Baxter, R.C.; Giedt, W.H.; Woodruff, L.W. (Lawrence Livermore National Laboratory, Livermore, California 94550). W-7405-ENG-48. *Journal of Applied Physics ;* **52**: No. 6, 4266-4275(Jun 1981).

The dynamic response of lead targets 0.025 mm and 0.05 mm thick to heating by a 1.0 MeV electron beam for about 50 ns is described. The lead targets were contained between a thin titanium tamping layer and a thick layer of fused quartz. Measured and predicted peak stresses in the quartz for no gap between the lead and the confining surfaces were approximately 12 kbar and agreed within 1 kbar. Peak stresses decreased rapidly with gap size to values, at 0.025-mm gaps, of about 1 kbar for the 0.025-mm lead targets and 5 kbar for the 0.05-mm targets. Predicted and measured values of tamper velocity (momentum) were within 10% only when the lead and confining walls were in close contact. The observed velocities for even very small gaps were substantially below predictions.

29039 Reply to "Comments on 'Raman scattering from boron-implanted laser annealed silicon' ". Engstrom, H.; Bates, J.B. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Journal of Applied Physics ;* **52**: No. 6, 4340(Jun 1981).

Because separate experiments have shown that our samples were well annealed, we disagree with the conculsion of Forman et al. [J. Appl. Phys. 52, 4337 (1981)], that accounting for the silicon optic mode lineshape requires inclusion of the effect of incomplete annealing.

29040 Neutron diffraction refinement of the crystal structure of erythritol at 22.6 K. Ceccarelli, C.; Jeffrey, G.A. (Pittsburgh Univ., PA (USA)); McMullan, R.K. (Brookhaven National Lab., Upton, NY (USA)). *Acta Crystallographica, Section B: Structural Crystallography and Crystal Chemistry ;* **36**: No. 12, 3079-3083(15 Dec 1980).

The structure of erythritol has been refined with 1077 neutron diffraction data measured at 22.6 K to an $R(F^2)$ of 0.041. The molecules in the crystal have orientational disorder about the C(2)-O(2) bond with H(O2) having 15% occupancy of an alternate site. Rigid-body analyses, based on the non-hydrogen atoms and on all atoms except the hydroxyl H atoms gave excellent fits. The bond lengths corrected for librational motion and the bond lengths corrected for riding motion are calculated. The H...O hydrogen-bond lengths and O-H...O angles (uncorrected) are 1.699 (2) A, 173.3 $(2)^0$; 1.788 (2) A, 164.5 $(2)^0$. The shorter O(1)-H...O(1) bonds form infinite helical chains about the 4_1 axes; the longer O(2)-H...O(2) bonds form closed quadrilaterals about the 4^- axes. The minor components of the disordered H atom form the same quadrilaterals about the 4^- axes in the opposite direction.

29041 Crystal structure of YDsub(1.96) and YHsub(1.98) by neutron scattering. Khatamian, D.; Kamitakahara, W.A.; Barnes, R.G.; Peterson, D.T. (Ames Lab., IA (USA)). *Journal of the Less-Common Metals ;* **74**: No. 1, 13-14(1 Oct 1980).

From International symposium on the properties and applications of metal hydrides; Colorado Springs, CO, USA (7 - 11 Apr 1980).

29042 Isotope effect on hydrogen site energies for two metal dihydrides. Venturini, E.L. (Sandia Labs., Albuquerque, NM (USA)). *Journal of the Less-Common Metals ;* **74**: No. 1, 45-54(1 Oct 1980).

From International symposium on the properties and applications of metal hydrides; Colorado Springs, CO, USA (7 - 11 Apr 1980).

The change in hydrogen site energy with isotope for dihydrides and dideuterides of scandium and yttrium was indirectly determined using electron spin resonance (ESR) of erbium ions in dilute concentration in the f.c.c. hosts. The ESR spectra measure the distribution of hydrogen adjacent to the erbium; the variations in this distribution with isotope and with hydrogen-to-metal ratio were studied for several samples of both host metals. The data are accurately described by a lattice-gas model which yields the energy difference for protons or deuterons on octahedral and tetrahedral sites, both adjacent to the erbium impurities and in the bulk host lattice. This energy difference is 10% greater for deuterons, and the change with isotope can be attributed primarily to the mass dependence of the vibrational part of the total energy associated with each site.

29043 Infrared spectra of the hydrogenated amorphous silicon layers on metallic substrates of solar absorbers. Soule, D.E.; Reedy, G.T. (Argonne National Lab., IL). *Thin Solid Films ;* **63**: 175-181(1979).

From International conference on metallurgical coatings; San Diego, CA, USA (23 Apr 1979).

Infrared-absorption spectra were investigated in hydrogenated amorphous silicon (a-Si(H) films deposited both by dc reactive

sputtering (RS) and by rf glow discharge (GD) of silane. The films were deposited onto polished niobium and tungsten solar test disks to form spectrally selective absorbers for comparative photothermal and photovoltaic studies. Spectra were observed from the normal spectral reflectance from 400 to 3900 cm^{-1} with a Fourier-transform spectrometer. Hydrogen, alloyed typically at 10 to 35 at. % in these a-Si films, significantly reduces the gap-state density and produces ir spectra characteristic of Si-H bonding complexes depending on the deposition method and the substrate temperature T/sub D/. Comparison between RS and GD films revealed significant differences in their ir spectra. RS films show a strong Si-O-Si bonding absorption from atmospheric oxygen. GD films have a marked Si-H wagging-mode absorption resolved into three components. This band is very sensitive to the deposition conditions and decays with increasing T/sub D/. The SiH_3 rocking mode was identified at 500 cm^{-1} in the GD films. The hydrogen concentration from the ir stretching-mode absorption was correlated with the H_2 evolution results of McMillan and Peterson on identical films. The transition with increasing T/sub D/ could be traced from the room temperature state with polymeric complexes of hydrogen to the high-temperature state with the single monohydride complex.

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29044 **(BNL—29707) Activation of Tl, Pb and Bi by 10-160 MeV neutrons: possible application to the analysis of Bi.** Parekh, P.P.; Finston, H.L. (Brookhaven National Lab., Upton, NY (USA); Brooklyn Coll., NY (USA)). 1981. Contract AC02-76CH00016. 14p. (CONF-810682—8). NTIS, PC A02/MF A01. Order Number DE81027300.

From 6. international conference: Modern trends in activation analysis; Toronto, Canada (15 Jun 1981).

The medium energy intense neutrons (MEIN) available at the Brookhaven Chemistry Linac Irradiation Facility have an energy distribution up to ~ 160 MeV and an effective neutron flux of ~ 1.3 x 10^{11} cm^{-2} s^{-1}. The present work explores the feasibility of using this facility for the analysis of Tl, Pb and Bi by activation with MEIN. The most sensitive reactions, from a practical standpoint, were found to be Tl (n, xn) ^{200}Tl (x = 4, 6), Pb (n, xn) ^{20x}/sup m/Pb (x = 0, 3, 4, 5) and ^{209}Bi (n, 6n) ^{204}Bi. The absolute sensitivities attainable with these reactions are 0.1, 0.05 and 0.08 μg of Tl, Pb and Bi respectively, for 1 h irradiation at 1.3 x 10^{11} n cm^{-2} s^{-1} with samples counted 2 h after the end of irradiation. The advantages of the method over thermal neutron activation analysis are that all three elements can be assayed at the sub-microgram concentration levels by γ-spectrometry with the help of a simple radiochemical purificaton and the analytical results can be verified by cross checking via the multiple (n, xn) reaction products. However, interference from Bi in the determination of Pb and from Pb and Bi in the determination of Tl limits its usefulness to the analysis of Bi.

29045 (CONF-801038—(Vol.2), pp 1321-1328) **Carbon tetrachloride desorption from activated carbon.** Jonas, L.A.; Sansone, E.B. (Environmental Control and Research Lab., Fredrick, MD). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Carbon tetrachloride was desorbed from a granular activated carbon subsequent to its adsorption under various vapor exposure periods. The varied conditions of exposure resulted in a range of partially saturated carbon beds which, when followed by a constant flow rate for desorption, generated different forms of the desorbing concentration versus time curve. A method of analyzing the desorption curves is presented which permits extraction of the various desorbing rates from the different desorption and to relate this to the time required for such regeneration. The Wheeler desorption kinetic equation was used to calculate the pseudo first order desorption rate constant for the carbon. The desorption rate constant was found to increase monotonically with increasing saturation of the bed, permitting the calculation of the maximum desorption rate constant for the carbon at 100% saturation. The Retentivity Index of the carbon, defined as the dimensionless ratio of the adsorption to the desorption rate constant, was found to be 681.

29046 **(DOE/ER/03126—40) Homogeneous liquid-liquid solvent extraction.** Ting, C.S.; Williams, E.T.; Finston, H.L. (Brooklyn Coll., NY (USA). Dept. of Chemistry). 1980. Contract AS02-76ER03126. 11p. (CONF-800918—6). NTIS, PC A02/MF A01. Order Number DE81027227.

From International solvent extraction conference; Liege, Belgium (6 Sep 1980).

This investigation was undertaken to extend the technique of homogeneous liquid-liquid solvent extraction into propylene carbonate. The mutual solubilities of propylene carbonate in water and vice-versa are shown in the phase diagram. The extraction of a variety of monodentate and bidentate ligand complexes with Fe(III) as a function of ligand concentration and pH were investigated. The monodentate ligands studied include, thiocyanate, chloride, bromide, benzoate, and bathophenanthrolines. The bidentate ligands studied include the various β-diketones, 8-quinolinol, and also cupferron which was studied under normal conditions, i.e., not under conditions of homogeneous extraction. The homogeneous extraction proved effective for a variety of chelate complexes and ion association complexes of iron giving, in all cases, very rapid extraction as compared with the slow rate of conventional extraction methods.

29047 **(DOE/ER/03126—42) Nuclear and radiochemical techniques in chemical analysis. Final report.** Finston, H.L.; Williams, E.T. (Brooklyn Coll., NY (USA). Dept. of Chemistry). Jun 1981. Contract AS02-76ER03126. 28p. NTIS, PC A03/MF A01. Order Number DE81027321.

The areas studied during the period of the contract included determinations of cross sections for nuclear reactions, determination of neutron capture cross sections of radionuclides, application of special activation techniques, and x-ray counting, elucidation of synergic solvent extraction mechanisms and development of new solvent extraction techniques, and the development of a PIXE analytical facility. The thermal neutron capture cross section of ^{22}Na was determined, and cross sections and energy levels were determined for ^{20}Ne(n,α)^{17}O, ^{20}Ne(n,P)^{20}F, and ^{40}Ar(n,α)^{37}S. Inelastic scattering with 2 to 3 MeV neutrons followed by counting of the metastable states permits analysis of the following elements: In, Sr, Cd, Hg, and Pb. Bromine can be detected in the presence of a 500-fold excess of Na and/or K by thermal neutron activation and x-ray counting, and as little as 0.3 x 10^{-9} g of Hg can be detected by this technique. Mediun energy neutrons (10 to 160 MeV) have been used to determine Tl, Pb, and Bi by (n,Xn) and (n,PXn) reactions. The reaction ^{19}F(P,α)^{16}O has been used to determine as little as 50 μmol of Freon -14. Mechanisms for synergic solvent extractions have been elucidated and a new technique of homogeneous liquid-liquid solvent extraction has been developed in which the neutral complex is rapidly extracted propylene carbonate by raising and lowering the temperature of the system. An external-beam PIXE system has been developed for trace element analyses of a variety of sample types. Various sample preparation techniques have been applied to a diverse range of samples including marine sediment, coral, coal, and blood.

29048 **(LA-UR—81-1646) Rapid, direct determination of organic sulfur in coal using electron-probe microanalysis.** Raymond, R. Jr. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 7p. (CONF-810914—1). NTIS, PC A02/MF A01.

From International conference on coal science; Dusseldorf, F.R. Germany (7 Sep 1981).

Electron probe microanalysis (EPM) for organic sulfur content can be performed easily on -20 to -100 mesh coal samples. Samples need only be mounted in epoxy and polished as coal samples are commonly prepared for petrographic examination. 15 areas within non-contiguous vitrinite grains are analyzed with the EPM. Without the need to produce a photomosaic, the organic sulfur content of vitrinite, and therefore of a coal, may be determined in less than 10 minutes. To test the EPM method coals were analyzed for which the ASTM organic sulfur values were corrected for unextracted iron. Such a correction would take into account the effect of any pyrite that remained unextracted following the ASTM

Standard Method D2492-68. As shown from the data the EPM organic sulfur contents are very close to those of the corrected ASTM values. Using the EPM method, the potential exists to achieve very rapid, multiple organic sulfur analyses, which in turn will allow for rapid, detailed measurements of variations in organic sulfur content occurring across coal seams.

29049 **(LA-UR—81-1966) Assay of low-level plutonium effluents.** Hsue, S.T.; Hsue, F.; Bowersox, D.F. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 9p. (CONF-810706—17). NTIS, PC A02/MF A01. Order Number DE81025344.

From Institute of Nuclear Materials Management conference; San Francisco, CA, USA (13 Jul 1981).

In the plutonium recovery section at the Los Alamos National Laboratory, an effluent solution is generated that contains low plutonium concentration and relatively high americium concentration. Nondestructive assay of this solution is demonstrated by measuring the passive L x-rays following alpha decay. Preliminary results indicate that an average deviation of 30% between L x-ray and alpha counting can be achieved for plutonium concentrations above 10 mg/L and Am/Pu ratios of up to 3; for plutonium concentrations less than 10 mg/L, the average deviation is 40%. The sensitivity of the L x-ray assay is ~ 1 mg Pu/L.

29050 **(RFP—3237) Scale-up of extraction chromatography using DHDECMP for the separation and purification of americium.** Yamada, W.I.; Martella, L.L. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1 Jun 1981. Contract AC04-76DP03533. 14p. (CONF-8106131—1). NTIS, PC A02/MF A01. Order Number DE81026476.

From 5. actinide separations workshop; Argonne, IL, USA (11 Jun 1981).

A combined anion exchange - bidentate extraction chromatography process for separation and purification of americium from Molten Salt Extraction (MSE) residues has been successfully demonstrated on a pilot plant scale. The extraction chromatography process uses DHDECMP (dihexyl-N,N-diethylcarbamoylmethylene-phosphonate) adsorbed on Amberlite XAD-4 resin. The process effectively recovers and purifies americium from impurity elements such as aluminum, calcium, copper, iron, potassium, magnesium, sodium, lead and zinc. A total of 100 g of americium oxide has been recovered. Calorimetry analysis of the product oxide indicates an americium g/g of 0.852. The product oxide contained 96.5% AmO_2, with a plutonium g/g of 0.00085 and less than 0.5% of any individual impurity element.

29051 **(SAND—81-1395C) Quantitative microanalysis of stainless steel carbides: x-ray absorption in $(Fe,Cr,V,Mo)_{23}C_6$ and (Nb, V)C.** Romig, A.D. Jr.; Sorenson, W.R. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 12p. (CONF-810705—5). NTIS, PC A02/MF A01. Order Number DE81027805.

From 16. annual conference of the Microbeam Analysis Society; Vail, CO, USA (13 Jul 1981).

X-ray absorption effects within metallurgical thin foils often complicate quantitative chemical microanalysis. Although absorption correction procedures are known, they become ambiguous when absorption occurs in more than one phase. A classic example of multiphase absorption occurs during the analysis of small second phase particles within a parent matrix. An excellent and often used solution to the problem of x-ray absorption in an adjacent parent phase is to physically remove the particle from the parent matrix. This is often accomplished by the use of extraction replicas. However, removing the particle from the matrix phase does not eliminate x-ray absorption within the extracted particle. It is the objective of this paper to show that quantitative x-ray microanalysis of extracted particles is not always routine. X-ray absorption within the extracted particles must be considered. Furthermore, standard absorption correction techniques can be shown to be, in many cases, suitable for treating the x-ray data generated within isolated particles.

29052 **(UCRL—85365) Analysis of standard reference materials by absolute INAA.** Heft, R.E.; Koszykowski, R.F. (Lawrence Livermore National Lab., CA (USA)). Jul 1981. Contract W-7405-ENG-48. 18p. (CONF-810682—7). NTIS, PC A02/MF A01. Order Number DE81025925.

From 6. international conference: Modern trends in activation analysis; Toronto, Canada (15 Jun 1981).

Three standard reference materials, flyash, soil, and ASI 4340 steel, were analyzed by a method of absolute instrumental neutron activation analysis (INAA). Two different light water pool-type reactors were used to produce equivalent analytical results even though the epithermal to thermal flux ratio in one reactor was higher than that in the other by a factor of two.

29053 **(UCRL—85597) Assay of 1-ammonium-3,5-dinitro-1,2,4-triazole and its determination in mixtures with ammonium nitrate.** Selig, W. (Lawrence Livermore National Lab., CA (USA)). Jul 1981. Contract W-7405-ENG-48. 11p. (CONF-810834—1). NTIS, PC A02/MF A01. Order Number DE81027133.

From 12. JANNAF propellant characterization meeting; Colorado Springs, CO, USA (18 Aug 1981).

Work is in progress at this Laboratory on the detonation calorimetry of ammonium dinitrotriazole (ADNT) and mixtures of ADNT and ammonium nitrate (AN). Our analytical requirements were therefore, twofold: (1) the assay of ADNT, and (2) the determination of ADNT in admixture with AN. The first requirement was straightforward and was accomplished by nonaqueous titration of ADNT, either as an acid or as a base. The second requirement, however, proved more difficult. It was accomplished by using cetypyridinium chloride (CPC), a new titrant recently introduced at this Laboratory to determine the ADNT in the mixture. Various liquid-membrane electrodes such as the fluoroborate, perchlorate, and nitrate ion-selective electrodes (ISE's) may be used as endpoint sensors. We have found that the solid-state cyanide (or iodide) ISE also senses the endpoint of this titration, although considerably smaller endpoint breaks are obtained. Nevertheless, the mean values obtained using the fluoroborate and cyanide ISE's differed by only 0.09%. The method can also be used for the assay of some ammonium salts of other nitroheterocycles. It cannot differentiate, however, between the various compounds.

29054 **Chemical kinetic functional sensitivity analysis: Derived sensitivities and general applications.** Demiralp, M.; Rabitz, H. (Department of Chemistry, Princeton University, Princeton, New Jersey 08544). *Journal of Chemical Physics ;* **75**: No. 4, 1810-1819(15 Aug 1981).

This paper considers possible applications of sensitivity analysis to kinetics problems defined in the space—time domain. At the outset it is assumed that elementary sensitivity functional densities $\delta u/\delta \alpha$ are available, where u is the ith chemical species concentration and α is the jth system parameter function. Emphasis is placed on the use of functional calculus to manipulate the elementary sensitivities for addressing a variety of physical questions. In this fashion, a family of derived sensitivities are generated from the elementary set. An extensive list of sensitivity applications is presented along with a discussion as an aid to future work.

29055 **Resonance absorption measurements of atom concentrations in reacting gas mixtures. VI. Shapes of the vacuum ultraviolet oxygen ($^3S—^3P$) resonance triplet from microwave sources and empirical calibration in a shock tube.** Pamidimukkala, K.M.; Lifshitz, A.; Skinner, G.B.; Wood, D.R. (Departments of Chemistry and Physics, Wright State University, Dayton, Ohio 45435). *Journal of Chemical Physics ;* **75**: No. 3, 1116-1122(1 Aug 1981).

Spectral line profiles of the atomic oxygen triplet $^3S_1—^3P$ emitted from microwave discharges in O_2—He mixtures containing 0.1% O_2 were measured in the 43rd order using a 2 m vacuum Czerny-Turner scanning spectrometer under three different lamp conditions. The profiles varied from nearly Gaussian to highly self-absorbed. The line shapes were accounted for by the amount of light absorbed by ground state oxygen atoms within the lamp. Experiments were carried out to calibrate the microwave discharge lamp for analysis of oxygen atoms using oxygen resonance triplet

absorption. Known concentration of O atoms were produced in the temperature range 1950—2600 K in a shock tube by the complete dissociation of dilute (1—20 ppM) mixtures of N_2O in Ar and related to the fraction of light absorbed. It was found that the ratios of the intensities of the oxygen components, measured using a low-resolution monochromator, can be used to obtain reasonably accurate calibration curves. Kinetic data obtained on N_2O dissociation as a part of our calibration experiments in the temperature range 1519—2408 K are also presented; the results are consistent with the correlations of Baulch et al. It was confirmed that O atom concentrations during calibration experiments were determined by stoichiometry, and not by the kinetics of N_2O dissociation.

29056 **AUTOSEP, an automated system for the quantitative ion exchange separation of plutonium from impurities.** Freeman, B.P.; Weiss, J.R.; Pietri, C.E. (New Brunswick Laboratory, U. S. Department of Energy, 9800 South Cass Avenue, Argonne, Illinois 60439). *Review of Scientific Instruments ;* **52**: No. 8, 1252-1255(Aug 1981).

The anion exchange separation of interfering impurities from plutonium in the Dowex-1 8 N HNO_3 system is a reliable purification method. An automated system, AUTOSEP, based on this manual procedure has been developed for greater productivity. Samples, in groups of ten, each containing 5—10 mg of plutonium are processed automatically in this system. AUTOSEP incorporates a means of programming reagent delivery, adjustment of the sample to the plutonium (IV) oxidation state via Fe(II) reduction/HNO_3 oxidation, plutonium sorption on the resin in 8 N HNO_3, washing of the resin bed with 8 N HNO_3 to remove impurities, elution of the purified plutonium with 0.36 N HCl—0.01 N HF, and waste effluent disposal. The reagents are delivered by gravity from a module whose only moving parts are rotary valves. The eluted plutonium solutions are collected for subsequent controlled-potential coulometric analysis. The average recovery of plutonium determined by controlled-potential coulometry using this apparatus was 100.00% with a relative standard deviation of 0.10%.

29057 **Novel method for angle determinations by EXAFS via a new multiple-scattering formalism.** Teo, B.K. (Bell Labs., Murray Hill, NJ). *Journal of the American Chemical Society ;* **103**: No. 14, 3990-4001(15 Jul 1981).

A new EXAFS (extended x-ray absorption fine structure) formulation which takes into account the effect of multiple scattering has been developed. Theoretical scattering amplitude and phase functions have been calculated for various scattering angles. Combining the new multiple-scattering formalism and the new theoretical functions enables the unraveling of the focusing effect as well as assessment of the relative angle determinations by EXAFS is devised and applied to a few known systems to illustrate the usefulness and accuracy of the technique. The accuracy for angle determination is better than 6% for low Z ($Z \leqq 10$) and 3% for high Z scatterers. In most cases, it amounts to an accuracy of better than ca. 5^0, which is comparable to the scattered range of crystallographically independent bond angles often observed in diffraction studies. The method requires no single-crystal measurements and is applicable to wide varieties of samples (polycrystalline or amorphous solids, liquids and solutions, gases, surfaces, polymers, etc.). This work also provides the first evidence that multiple-scattering processes can be important in determining the EXAFS of distant shells, especially at large bond angles.

29058 **Calculation of dispersion for a plane grating in a Czerny-Turner mount: a comment.** Radziemski, L.J. (University of California, Los Alamos National Laboratory, P.O. Box 1663, Los Alamos, New Mexico 87545). *Applied Optics ;* **20**: No. 11, 1948-1950(1 Jun 1981).

Recently a variety of array detectors have been used in the focal plane of Czerny-Turner plane-grating spectrometers. The output signals have been coupled to a variety of storage units, resulting in optical multi-channel analyzers (OMA). We present a clarification of the method for calculating the dispersion of this instrument, as well as a table of useful spectroscopic parameters for spectrometer-detector array combinations.

29059 **Errors in determining elemental concentrations and the structure of interelement correlation matrices.** Pinder, J.E. III; Giesy, J.P. (Savannah River Ecology Lab., Aiken, SC). *Ecology ;* **62**: No. 2, 483-485(1981).

Although correlations among elemental concentrations can result from physiological or kinetic similarities among elements; correlations may also result from analytical errors in determining concentrations. Correlations may also result from matrix interferences. Most studies of interelement correlation matrices have assumed that correlations resulting from errors are zero or at least negligible. Interelement correlation matrices, however, are often calculated where the majority of the concentrations have been determined by the same procedure on a single aliguant. In a previous study we partitioned the total variance in elemental concentrations in largemouth bass into components due to variation among individual fish, variation among subsamples from the same individual, and unexplained residual variance, which contains the effects of analytical errors in determining concentrations as well as other sources of variation. Although we only partitioned the variances of concentrations, it is also possible to partition the covariance among elemental concentrations into components due to fish, subsample, and unexplained residual variation and test the assumption that the subsampling and unexplained residual variation components are negligible. The purpose of this note is to demonstrate this process and to show that the presence of covariance, and hence correlations, due to analytical errors can occur and influence the analyses of interelement correlations.

29060 **Utility wastewater chemistry and measurement problems.** Warner, J.D. (Baltimore Gas and Electric Co., MD). pp 1-3 of Instrumentation in the power industry, Volume 23. Good, E.M. (ed.). Research Triangle Park, NC; Instrument Society of America (1980).

From 23. ISA power instrumentation symposium; Chicago, IL, USA (14 May 1980).

This paper discusses normal and extreme water chemistry conditions in operating utility wastewater plants and describes the problems encountered with the instruments used. The chemistry involved and the retrospective measurement experience will be compared for typical National Pollution Discharge Elimination System discharge criteria, to illustrate some actual needs and performance.

4002 Inorganic And Physical Chemistry

REFER ALSO TO CITATION(S) 28362, 29100, 29104, 29108

29061 **(DOE/ER/05031—3) Isotope effects in the solution of gases in liquids. Progress report, November 1, 1980-June 30, 1981.** Benson, B.B.; Krause, D. Jr. (Amherst Coll., MA (USA)). Jun 1981. Contract AS02-78ER05031. 8p. NTIS, PC A02/MF A01. Order Number DE81027191.

An harmonic potential model has been developed for the isotopic fractionation of gases dissolved in liquids. When coupled with our experimental data it yields values for the force constant for the interaction between the solute molecule and the solvent, for the minimum diameter of the cavity in which the solute molecule moves, and for the frequency of oscillation of the solute molecules. Current experimental effort is directed toward isotopic fractionation in non-aqueous solvents.

29062 **(IS-M—314) Rare earth speciality inorganic compounds.** Gschneidner, K.A. Jr. (Ames Lab., IA (USA); Iowa State Univ. of Science and Technology, Ames (USA). Rare-Earth Information Center). 1981. Contract W-7405-ENG-82. 41p. (CONF-810919—1). NTIS, PC A03/MF A01. Order Number DE81023776.

From Conference on speciality inorganic chemicals; Salford, UK (10 Sep 1981).

This paper is a comprehensive review of the rare earth elements which include the Group IIIA elements Sc, Y and the lanthanide elements La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb and Lu. It covers their abundances, electronic structure, ionic radii, energy levels, thermodynamic properties, optical applications, separation chemistry, markets and statistics, electronic and magnetic applications, as well as mineral ores that contain rare

earths, mixed rare earth chemical, and special uses of Y_2O_3. 30 references.

29063 **(LBL—12625) Speciation of labile and quasi-labile metal complex systems using the Kalman filter.** Brown, T.F.; Caster, D.M.; Brown, S.D. (California Univ., Berkeley (USA). Dept. of Chemistry; Lawrence Berkeley Lab., CA (USA)). May 1981. Contract W-7405-ENG-48. 8p. (CONF-810588—3). NTIS, PC A02/MF A01. Order Number DE81025678.

From DOE/NBS workshop on environmental speciation and monitoring needs; Gaithersburg, MD, USA (18 May 1981).

One approach used in the study of trace metal speciation is the measurement of metal complex stability constants, which are then combined with models of the metal systems under study to predict the species present. The electrochemical techniques used to measure metal complex species have the advantage of sensitivity and specificity, but suffer a number of limitations. For voltammetric techniques, these include requirements of excess ligand and rapid kinetics. We have developed a new approach to voltammetric studies of metal complexes; this approach uses the Kalman filter, a recursive, linear, digital filter, to model overlapped electrochemical peaks arising from parallel reduction paths, including the situation where two or more complexes undergo slow exchange. Stability constants are calculated from the individual electrochemical responses extracted by the filter. This approach has been applied to studies of the complexation of NTA with various trace metals. A description of the model and results for the systems will be discussed.

29064 **(LBL—12871) Organometallic chemistry of metal surfaces.** Muetterties, E.L. (Lawrence Berkeley Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 17p. (CONF-810824—1). NTIS, PC A02/MF A01. Order Number DE81025324.

From 10. international conference on organometallic chemistry; Toronto, Ontario, Canada (9 Aug 1981).

The organometallic chemistry of metal surfaces is defined as a function of surface crystallography and of surface composition for a set of cyclic hydrocarbons that include benzene, toluene, cyclohexadienes, cyclohexene, cyclohexane, cyclooctatetraene, cyclooctadienes, cyclooctadiene, cycloheptatriene and cyclobutane. 12 figures.

29065 **(ORNL/TM—7515) Literature survey of the aqueous chemistry of technetium related to photolysis.** Friedman, H.A. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 48p. NTIS, PC A03/MF A01. Order Number DE81027677.

A literature survey was made to accumulate information about the chemistry of technetium as it relates to photolysis. The electrochemical potentials and the reactions of the various technetium compounds and complexes are discussed, along with the various absorption spectra of the different species. The $TcCl_6^{2-}$ ion has been shown to be photochemically active in HCl solutions. Hexachlorotechnetate(IV) is oxidized when exposed to sunlight in concentrated HCl. A ligand change occurs when it is exposed to either 254- or 34-nm radiation in more dilute HCl. No other photolysis reactions were found in the literature. It is possible that, under appropriate conditions, other valence states of technetium would be photochemically active, resulting in either redox or ligand exchange reactions. Proposals for investigating the photochemical reduction of the pertechnetate in HNO_3 and other media are discussed.

29066 **(RFP—3185) Vaporization and thermodynamic properties of samarium dicarbide ans substoichiometric disamarium tricarbide.** Haschke, J.M.; Deline, T.A. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant; Michigan Univ., Ann Arbor (USA). Dept. of Chemistry). 1981. Contract AC04-76DP03533. 23p. (CONF-810675—2). NTIS, PC A02/MF A01. Order Number DE81027257.

From 15. rare earth research conference; Rolla, MO, USA (15 Jun 1981).

The vaporization reactions of SmC_2(s) and Pu_2C_3-type SmC/sub y/(s) have been characterized and equilibrium pressures have been measured using a target-collection effusion technique. The carbides vaporize incongruently as follows: $SmC_2(s) \rightarrow 2C(s) + Sm(g)$, and $2/(2\text{-}y)\ SmCy(s) \rightarrow y/(2\text{-}y)\ SmC_2(s) + Sm(g)$. The complex reaction for SmC/sub y/ occurs because the composition of the carbon-rich boundary of the phase decreases as temperature increases. For the first reaction, the equilibrium pressure is described by log P(Sm, g, atm, 1548 K < T < 2049 K) = (3.60 +- 0.01) - (14309 +- 21)T^{-1}. The non-linear pressure equation for the second reaction is log P(Sm, g, atm, 1.42 < y < 1.44, 1372 K < T < 1636 K) = [(12.009 - 28449 T^{-1} + 7018500 T^{-2}) +- 0.038]. Thermodynamic values for the vaporization and formation reactions of SmC_2(s) and SmC/sub y/(s) at 298°K have been calculated; ΔH/sub f/° (SmC_2,s, 298°K) = -(96.2 +- 7.5) kJ mol^{-1} and ΔH/sub f/° ($SmC_{1.43}$,s, 298°K) = -(89.0 +- 8.0) kJ mol^{-1}. The thermodynamic results are discussed and compared with values reported for other lanthanide carbides.

29067 **(SRIA—115P56-12) Reaction of metal halides with carbon. Progress report, October 26, 1967-January 26, 1968.** (Stanford Research Inst., Menlo Park, CA (USA)). 16 Feb 1968. Contract AM03-76SF00115. 7p. NTIS, PC A02/MF A01. Order Number DE81026097.

Mass spectrometer studies of the reaction of $NbCl_5$(g) with Nb(s) indicated that the gaseous reaction mixture probably contained $NbCl_5$, $NbCl_4$, and $NbCl_3$. No species were observed with molecular weights higher than $NbCl_5$. Transpiration experiments at 1386°C (1659°K) gave Cl/Nb ratios between 3.1 and 3.5. The entropy of solid niobium pentachloride has been calculated to be $S_{298}°$ (solid) = 50.42 e.u.

29068 **(SRIA—115P56-13) Thermodynamics of niobium chlorides. Final report, 26 April 1965-30 June 1968.** Keneshea, F.J.; Cubicciotti, D. (Stanford Research Inst., Menlo Park, CA (USA)). 5 Jul 1968. Contract AM03-76SF00115. 40p. NTIS, PC A03/MF A01. Order Number DE81026099.

The equilibrium between Nb metal and gaseous $NbCl_5$ was studied primarily by transpiration measurements of the densities of niobium and chlorine in the vapor in equilibrium with solid niobium at elevated temperatures. Mass spectrometer studies of a molecular beam effusing from a niobium Knudsen cell into which $NbCl_5$ or Cl_2 was led confirmed the proposal that the important vapor species were $NbCl_5$, $NbCl_4$, and $NbCl_3$. The transpiration data were analyzed so as to derive the equilibrium constants for the reactions: $1/4\ Nb(s) + NbCl_5(g) = 5/4\ NbCl_4(g)$; K_{54} and $1/3\ Nb(s) + NbCl_4(g) = 4/3\ NbCl_3(g)$; K_{43}. To accomplish this analysis, K_{54} was evaluated at the lowest temperature studied where $NbCl_5$ and $NbCl_4$ were the primary species. The heats of formation of $NbCl_5$ and $NbCl_4$ were used to determine the change in K_{54} with temperature and so to evaluate K_{54} at the higher temperatures. At the higher temperatures of our experiments, $NbCl_4$ and $NbCl_3$ were the primary species, and the values of K_{43} were determined at those temperatures. As part of this work, enthalpy increments above room temperature were measured for the condenced phases of $NbCl_5$. With these data the vapor pressures of $NbCl_5$ were analyzed by a Σ-plot treatment to derive the enthalpy and entropy of sublimation, which were found to be $\Delta H_{298}°$(subl) = 22.41 kcal/mole and $\Delta S_{298}°$(subl) = 45.40 e.u. These data were used to evaluate the enthalpy of formation of gaseous $NbCl_5$ (-168.1 kcal/mole) and the absolute entropy of solid $NbCl_5$ (50.4 e.u.) at 298°K. For $NbCl_4$, the enthalpy and entropy of sublimation at 298°K were calculated to be 32.8 kcal/mole and 44.9 e.u., and the enthalpy of the formation gas was calculated to be -133.2 kcal/mole. For $NbCl_3$, the enthalpy of formation of gas was found to be -83 kcal/mole at 298°K.

29069 **(UCD—34P168-3) Thermodynamics of lithium and hydrogen isotope-exchange reactions. Final report.** Rock, P.A. (California Univ., Davis (USA). Dept. of Chemistry). 30 Aug 1972. Contract AM03-76SF00034. 124p. NTIS, PC A06/MF A01.

The equilibrium constants of the isotope-exchange reactions: (1) $^7Li(s) + {}^6LiBr(digl) = {}^6Li(s) + {}^7LiBr(digl)$; (2) $^7Li(s) + {}^6LiBr(PC) = {}^6Li(s) + {}^7LiBr(PC)$; (3) $^7Li(s) + {}^6LiCl(H_2O) = {}^6Li(s) + {}^7LiCl(H_2O)$; (4) $D_2(g) + 2HCl(DMF) = H_2(g) + 2DCl(DMF)$; and (5) $D^+(DMF) + HCl(DMF) = H^+(DMF) = DCl(DMF)$ (where digl is diglyme, PC is propylene carbonate, and

DMF is N,N-dimethylformamide) have been determined using electrochemical double and quadruple cells without liquid junction and conductance measurements. The experimental K values have been compared with K values calculated from the statistical-thermodynamic theory of isotope-exchange reactions applied to models for the above reactions. The calculations show that reliable theoretical estimates can be made for symmetric lithium and hydrogen isotope-exchange reactions.

29070 **Geometry and electronic structure of $(CO)_3NiCH_2$. A model transition-metal carbene.** Spangler, D.; Wendoloski, J.J.; Dupuis, M.; Chen, M.M.L.; Schaefer, H.F. III. (Univ. of California, Berkeley). Contract W-7405-ENG-48. *Journal of the American Chemical Society ;* **103**: No. 14, 3985-3990(15 Jul 1981).

The first application of nonempirical molecular electronic structure theory to a realistic transition-metal carbene complex is reported. The system chosen was $(CO)_3NiCH_2$, methylene(tricarbonyl)nickel(0). All studies were carried out at the self-consistent-field (SCF) level. A large and flexibly contracted basis set was chosen, labeled Ni(15s 11p 6d/11s 8p 3d), C,O(9s 5p/4s 2p), H(5s/3s). The critical predicted equilibrium geometrical parameters were R[Ni-C(methylene)] = 1.83 A, θ(HCH) = 108°. The sixfold barrier to rotation about the Ni-C(methylene) axis is small, ~ 0.2 kcal. The electronic structure of $(CO)_3NiCH_2$ is discussed and compared with those of the naked complex $NiCH_2$ and the stable $Ni(CO)_4$ molecule. 4 figures, 4 tables.

29071 **Structure of molecular complexes of copper uroporphyrin with aromatic heterocycles.** Shelnutt, J.A. (Sandia National Labs., Albuquerque, NM). Contract AC04-76DP00789. *Journal of the American Chemical Society ;* **103**: No. 14, 4275-4277(15 Jul 1981).

Raman differences spectroscopy was used to study copper uroporphyrines with seventeen addends. The frequency differences, while small (~ 1.0 cm^{-1}), indicate large redistributions of the π electrons of the ring. (DLC)

29072 **Decomposition of ammonia on rhodium crystals.** Vavere, A.; Hansen, R.S. (Iowa State Univ., Ames). Contract W-7405-ENG-82. *Journal of Catalysis ;* **69**: No. 1, 158-171(May 1981).

The rates of ammonia decomposition of (110), (100), and (111) single-crystal faces of rhodium were measured over the temperature range 580 to 725 K for ammonia pressures ranging from 1 x 10^{-3} to 500 x 10^{-3} torr and hydrogen and nitrogen pressures varying from 1 x 10^{-3} to 150 x 10^{-3} torr and 1 x 10^{-3} to 250 x 10^{-3} torr, respectively. The decomposition rates were proportional to P/sup 1/2//sub NH3/ and P/sub NH3/ at low and high hydrogen pressure, respectively. The H_2 kinetic order varied from 0 (low P/sub H2/) to -1.0 (high P/sub H2/). The rate was independent of nitrogen pressure. Isotope studies indicated that NH_3 decomposes about 1.5 times faster than ND_3 on the (110) and (111) faces. A large face specificity is evident with the rates on the (110) surface over 10 times as great as those on the (111) surface. LEED, AES, and flash desorption experiments indicated that boron (B) was a significant surface poison and that the Rh(110) surface under reaction conditions might contain at most moderate coverages of nitrogen adatoms, but that coverages of other species were very small. The LEED/AES characterizations were done in a different system from that used in the kinetic and thermal desorption experiments. Rate expressions consistent with the observed kinetics are derived from a model involving surface species Rh_2NH, RhH, and RhN, with only the RhN coverage being appreciable under the experimental conditions used. The kinetic data for the Rh (110) face are semiquantitatively fit to these rate expressions via a superposition technique and also to an empirical rate expression which functionally is similar to the mechanism rate equation. A decreasing NH_3 order (< 1/2) at high P/sub NH3/ and low T is attributed to the buildup of surface nitrogen. Kinetic orders and activation energies obtained are generally consistent with most other literature data.

29073 **Reactions of aryl isocyanates with hydridotriosmium carbonyl cluster compounds.** Adams, R.D.; Golembeski, N.M.; Selegue, J.P. *Inorganic Chemistry ;* **20**: No. 4, 1242-1247(Apr 1981).

Results of studies of the reactivity of the hydridotriosmium carbonyl clusters $H_2Os_3(CO)_9L$ where L = CO or $P(CH_3)_2C_6H_5$ with aryl isocyanates are reported. These studies were undertaken in an attempt to explain the nature of the hydride transfers from the cluster compounds currently attracting attention as a source of homogeneous catalysts substrates. These compounds are electron deficient and readily react with donor molecules to form electron saturated 1:1 adducts. The results suggest that the isocyanate molecule enters the cluster at the hydrogen-bridged osmium-osmium bond which is presumed to be the cite of highest reactivity. In all cases changing the ligand structure of the cluster has caused a pronounced change in the regio-selectivity of the hydrogen transfer. (BLM)

29074 **Crystal structure of 3-R $Nb_{1.06}S_2$.** Powell, D.R.; Jacobson, R.A. (Ames Lab., IA). Contract W-7405-ENG-82. *Journal of Solid State Chemistry ;* **37**: No. 2, 140-143(Apr 1981).

The x-ray single crystal structure of 3-R $Nb_{1.06}S_2$ has been determined. The material crystallizes in the space group R/sub 3m/ with a = 3.3285(4) and c = 17.910(04) A when indexed on a hexagonal lattice. The structure was refined by full matrix least squares procedures to a final residual of R = 0.026 based on 79 observed (I > 3 σ_1) reflections. The sulfurs form closest-packed layers with the majority of the metal in sheets of trigonal prismatic sites. A small portion of niobium was found to occupy octahedral sites, between the van der Waals gaps of the sulfur lattice. Niobium in the van der Waals region is trigonally distorted from octahedral symmetry, with niobium-sulfur distances of 2.234(8) and 2.577(11) A, because of repulsion from niobium in adjacent trigonal prismatic layers.

29075 **Phenomenological and structural study of a low-temperature phase transition in the $PbZrO_3$-$PbTiO_3$ system.** Amin, A. (Pennsylvania State Univ., University Park); Newnham, R.E.; Cross, L.E.; Cox, D.E. Contract EY-76-C-02-0016. *Journal of Solid State Chemistry ;* **37**: No. 2, 248-255(Apr 1981).

The Landau-Ginsburg-Devonshire phenomenological theory has been applied to the $PbZrO_3$-$PbTiO_3$ crystalline solid solution system to explore the behavior of the rhombohedral-tetragonal morphotropic phase boundary in the region below room temperature. The theory suggests that morphotropy is preserved, i.e., that the phase boundary occurs at nearly the same composition right down to 0°K. The rhombohedral (3Rm)-rhombohedral (R3c) phase transition was investigated for a composition $PbZr_{0.6}Ti_{0.4}O_3$ using neutron diffraction. Structures in both phases were refined by the Rietveld profile fitting technique. The transition behavior in this composition was indicative of a diffuse-type phase transition, with a transition temperature somewhere between 250 and 300°K. The diffuse nature of this transition is perhaps due to short-range ordering of Zr and Ti. However, powder neutron diffraction is not ideal for determining critical behavior; therefore, it is difficult to make a quantitative conclusion in this respect. Values of the spontaneous polarization were obtained from the (Zr/Ti) shifts, and compared to those deduced from phenomenological theory.

29076 **Synthesis and structure of an infinite-chain form of ZrI_2 (α).** Guthrie, D.H.; Corbett, J.D. (Ames Lab., IA). *Journal of Solid State Chemistry ;* **37**: No. 2, 256-263(Apr 1981).

The synthesis of a second polymorph of ZrI_2 has been achieved by a transport reaction between ZrI_4 and zirconium metal under a 750/850°C gradient in a sealed tantalum tube. The black lath-like crystals produced in the 775°C region occur in space group $P2_1/m$ with a = 6.821(2) A, b = 3.741(1) A, c = 14.937(3) A, β = 95.66(3)°, Z = 4. A total of 669 independent reflections with 2 theta ≦ 50° and I > 3 σ(I) were measured at room temperature on a four-circle automated diffractometer with monochromatized MoKα radiation and were corrected for absorption (μ = 190 cm^{-1}). The structure was solved by direct methods and full-matrix least-squares refinement of all atoms with anisotropic thermal parameters to give final residuals R = 0.064 and R/sub w/ = 0.079. This phase is isoelectronic and isostructural with β-$MoTe_2$, a distorted CdI_2-type structure in which the zirconium atoms are displaced 0.440 A from the octahedral centers along a to form infinite zigzag metal chains (d/sub ZR-ZR/ = 3.182(3) A) parallel to b.

The phase is a diamagnetic semiconductor at room temperature (E/ sub g/ ~ 0.1 eV).

29077 **Ultraviolet spectroscopic study of ferric equilibria at high chloride concentrations.** Byrne, R.H. (Univ. of South Florida, St. Petersburg); Kester, D.R. Contract EE-77-S-05-5486. *Journal of Solution Chemistry ;* **10**: No. 1, 51-67(Jan 1981).

The equilibria among the species Fe^{3+}, $FeCl^{2+}$, $FeCl_2^+$, $FeOH^{2+}$ and $Fe(OH)_2^+$ have been examined by ultraviolet absorption spectroscopy. Our results indicate that previous workers have generally overestimated the stability constant of $FeCl^{2+}$ and that the association of Fe^{3+} and Cl^- is predominantly inner sphere. The formation constant of $FeOH^{2+}$ obtained in 0.68 m NaCl is in good agreement with our earlier results obtained in 0.68 m $NaClO_4$. Our results indicate that formation of $FeOHCl^+$ is much less significant than has been previously reported. Molar absorptivities for the species Fe^{3+}, $FeCl^{2+}$, $FeCl_2^+$ and $FeOH^{2+}$ are reported for wavelengths between 220 and 400 nanometers.

29078 **Proton NMR of $H_{1\ 7}MoO_3$ and $YH_{1\ 92}$.** Taylor, R.E. Ames, IA; Iowa State Univ. (1980). 92p. University Microfilms Order No. 80-28,637.

Thesis (Ph. D.).

Nuclear magnetic resonance (NMR) spectroscopy has been used since its inception to study chemical systems in the solid state. In general, these studies have dealt with measurements of relaxation times or interpretations of the NMR absorption spectrum in terms of the largest interaction present. However, the use of recently developed NMR techniques allows the separation and characterization of the interactions present. The work reported in this dissertation deals with the application of existing proton NMR techniques as well as the extension of high resolution techniques and their use to learn more about the nature and mobility of protons in $H_{1\ 7}MoO_3$ and $YH_{1\ 92}$.

29079 **Theoretical upper-bound limitations for mixed-ligand complexes in solution.** Byrne, R.H. (Univ. of South Florida, St. Petersburg). Contract EE-77-S-05-5486. *Marine Chemistry (Amsterdam) ;* **9**: 75-80(1980).

Theoretical considerations allow the calculation of the potential significance of mixed-ligand solution complexes. It can be shown that the solution concentration, [MXY], of a chemical species, MXY, cannot represent more than 50% of a metal's total dissolved concentration, M/sub T/. For higher ligand number mixed-ligand complexes it is found that ($[MX_2Y] + [MXY_2]$)/M/sub T/ ≦ 0.75 and ($[MX_3Y] + [MX_2Y_2] + [MXY_3]$)/M/sub T/ ≦ 0.875. In high average ligand number systems, mixed complexes, MX/sub a/ Y/sub b/, can dominate a metal's solution chemistry even when only one single-ligand type species, MX/sub a+b/, is important. Mixed-ligand complexes may dominate the chemistry of highly associated hydrothermal solutions. 3 figures.

29080 **High resolution infrared matrix isolation spectroscopy of SF_6 and BCl_3.** Jones, L.H.; Swanson, B.I.; Ekberg, S.E. (Los Alamos Scientific Lab., NM). *Chemical Physics Letters ;* **68**: No. 2, 3, 499-500(15 Dec 1979).

This note reports infrared spectra of SF_6 and BCl_3 in argon matrices at 10 K and 0.04 cm^{-1} resolution. At this resolution we observe a wealth of structure not observed at the commonly used resolution of 0.5 cm^{-1} or poorer. Analyses of such spectra will yield important information on the structure and dynamics of low temperature matrices. 2 figures.

4003 Organic Chemistry

REFER ALSO TO CITATION(S) 28080, 28222, 28361, 29064, 29069, 29071, 29073, 29092, 29100

29081 (CONF-801038—(Vol.1), pp 125-139) **Size distributions of aerosols produced from substitute materials by the Laskin cold DOP aerosol generator.** Hinds, W.; Macher, J.; First, M.W. (Harvard School of Public Health, Boston, MA). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Test aerosols of di(2-ethylhexyl)phthalate (DOP) produced by Laskin nozzle aerosol generators are widely used for in-place filter testing and respirator fit testing. Concern for the health effects of this material has led to a search for substitute materials for test aerosols. Aerosols were generated with a Laskin generator and diluted 6000-fold with clean air. Size distributions were measured for DOP, di(2-ethylhexyl)sebecate, polyethylene glycol, mineral oil, and corn oil aerosols with a PMS ASAS-X optical particle counter. Distributions were slightly bimodal with count median diameters from 0.22 to 0.30 μm. Size distributions varied little with aerosol material, operating pressure, or liquid level. Mineral oil and corn oil gave the best agreement with the DOP size distribution.

29082 **(LBL—12801) Reaction of oxygen atoms with ethylene and vinylbromide.** Buss, R.J.; Baseman, R.J.; He, G.; Lee, Y.T. (Lawrence Berkeley Lab., CA (USA)). May 1981. Contract W-7405-ENG-48. 23p. (CONF-810922—1). NTIS, PC A02/MF A01. Order Number DE81025206.

From 10. international conference on photochemistry; Iraklion, Crete, Greece (6 Sep 1981).

Identification of the primary products in the reaction of $O(^3P)$ atoms with ethylene and vinyl bromide has been accomplished by measurement of the angular and velocity distributions of the products in a crossed beam apparatus under single collision conditions. The atomic elimination processes are found to be the major channels while molecular elimination is not observed. The 1,2 migration of H atom in the intermediate complex is not observed to occur.

29083 **(SAND—81-1353C) Shock-induced organic chemistry.** Dodson, B.W.; Graham, R.A. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 16p. (CONF-810684—35). NTIS, PC A02/MF A01. Order Number DE81024442.

From APS conference on shock waves in condensed matter; Menlo Park, CA, USA (23 Jun 1981).

A wide variety of chemical ractions are known to occur in organic compounds subjected to shock loading. An overview is presented of the evidence that (a) shock loading can cause nonthermal reactions, i.e., reactions which do not take place under equivalent combinations of static temperature and pressure; (b) unique and/or unusual reactions can occur under shock; and (c) reactions can occur in the shock front itself. Rules obtained for reactivity of organic compounds under shock loading are used to address the problem of initiation sensitivity of aromatic explosives.

29084 **Local mode excitation and direct unimolecular reaction rate measurements in tetramethyldioxetane.** Cannon, B.D.; Crim, F.F. (Department of Chemistry, University of Wisconsin, Madison, Wisconsin 53706). *Journal of Chemical Physics ;* **75**: No. 4, 1752-1761(15 Aug 1981).

Direct excitation of overtone vibrations combined with time-resolved detection of product chemiluminescence produces both overtone vibration excitation spectra and directly measured unimolecular decay rates of tetramethyldioxetane. The spectra show increasingly pure local mode character in higher vibrational levels and exhibit splittings which arise from nonequivalent sites occupied by methyl hydrogens. The temporal evolution of the signal reflects the unimolecular decomposition rate of the highly vibrationally excited molecule, and comparing the observed behavior to Rice—Ramsperger—Kassel—Marcus theory calculations shows that they adequately describe the decomposition if properly averaged over the thermal vibrational energy content of the molecule.

29085 **Chemical thermodynamic properties and internal rotation of methylpyridines. III. 4-Methylpyridine.** Draeger, J.A.; Scott, D.W. (Bartlesville Energy Technology Center, Department of Energy, Bartlesville, Oklahoma 74003). *Journal of Chemical Physics ;* **75**: No. 4, 2016-2018(15 Aug 1981).

The ideal gas state thermodynamic properties of 4-methylpyridine have been calculated based on free internal rotation of the methyl group. Selected values are compared with accurate experimental results. (AIP)

29086 Dynamical effects on conformational isomerization of cyclohexane. Hasha, D.L.; Eguchi, T.; Jonas, J. (Department of Chemistry, School of Chemical Sciences and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801). *Journal of Chemical Physics ;* **75**: No. 3, 1571-1573(1 Aug 1981).

The pressure dependence is studied for the isomerization rate of cyclohexane in solvents of acetone-d_6, carbon disulfide, and methycyclohexane-d_{14}. (AIP)

29087 Energetics of the rearrangement of neutral and ionized perfluorocyclopropane to perfluoropropylene. Use of infrared multiphoton dissociation spectra to identify structural isomers of molecular ions. Bomse, D.S.; Berman, D.W.; Beauchamp, J.L. (California Inst. of Tech., Pasadena). *Journal of the American Chemical Society ;* **103**: No. 14, 3967-3971(15 Jul 1981).

Infrared photodissociation spectroscopy is used to compare the structure of gas-phase $C_3F_6^+$ ions obtained by electron-impact ionization of two isomeric precursors: perfluoropropylene and perfluorocyclopropane. Photodissociation spectra are obtained by observing the extent of multiphoton dissociation as the CO_2 laser is tuned across the 925 to 1080 cm^{-1} wavelength range. Ions are formed, stored, and detected with the use of techniques of ion cyclotron resonance spectroscopy. Infrared multiphoton excitation is effected by using low-power, continuous-wave laser radiation. The fingerprint spectrum of the molecular ion of perfluorocyclopropane is identical with that obtained from perfluoropropylene, indicating rearrangement of the former to the latter. Photodissociation kinetics indicate that the entire perfluorocyclopropane molecular ion population isomerizes to the more stable perfluoropropylene structure. Thermochemistry of C_3F_6 and $C_3F_6^+$ isomers is discussed. Comparisons are made with the analogous C_3H_6 system. Photoionization mass spectroscopy results yield $\Delta H/sub\ f/(c\text{-}C_3F_6) = -233.8$ kcal/mol. 4 figures.

29088 Kinetic evidence for the formation of discrete 1,4-dehydrobenzene intermediates. Trapping by inter- and intramolecular hydrogen atom transfer and observation of high-temperature CIDNP (chemically induced dynamic nuclear polarization). Lockhart, T.P.; Comita, P.B.; Bergman, R.G. (Univ. of California, Berkeley). Contract W-7405-ENG-48. *Journal of the American Chemical Society ;* **103**: No. 14, 4082-4090(15 Jul 1981).

Upon being heated, alkyl-substituted cis-1,2-diethynyl olefins undergo cyclization to yield reactive 1,4-dehydrobenzenes; the products isolated may be derived from either unimolecular or bimolecular reactions of the intermediate. (Z)-4,5-Diethynyl-4-octene (4) undergoes rearrangement to yield 2,3-di-n-propyl-1,4-dehydrobenzene (17). Solution pyrolysis of 4 in inert aromatic solvents produces three unimolecular products, (Z)-dodeca-4,8-diyn-6-ene (7), benzocyclooctene (9), and o-allyl-n-propylbenzene (10), in high yield. When 1,4-cyclohexadiene is added to the pyrolysis solution as a trapping agent high yields of the reduced product o-di-n-propylbenzene (12) are obtained. The kinetics of solution pyrolysis of 4 in the presence and absence of trapping agent pyl-1,4-dehydrobenzene is a discrete intermediate on the pathway leading to products. When the reaction was run in the heated probe of an NMR spectrometer, chemically induced dynamic nuclear polarization was observed in 10. This observation, along with kinetic and chemical trapping evidence, indicates the presence of two additional intermediates, formed from 17 by sequential intramolecular [1,5] hydrogen transfer, on the pathway to products. The observation of CIDNP, coupled with the reactivity exhibited by 17 and the other two intermediates, implicates a biradical description of these molecules.

29089 Evidence for the reactive spin state of 1,4-dehydrobenzenes. Lockhart, T.P.; Bergman, R.G. (California Inst. of Tech., Pasadena). Contract W-7405-ENG-48. *Journal of the American Chemical Society ;* **103**: No. 14, 4091-4096(15 Jul 1981).

Two approaches have been used to investigate the spin state(s) of 1,4-dehydrobenzenes produced in the solution thermolysis of diethynyl olefins. One method relies on the spin correlation effect which postulates a relationship between the spin state of a caged radical pair and the ratio of cage and escape reactions (C/E) which may occur in the pair. When the 2,3-di-n-propyl-1,4-dehydrobenzene biradical (4) abstracts hydrogen from 1,4-cyclohexadiene, a radical pair is generated. If a mixture of 1,4-cyclohexadiene-d_0 and -d_4 is employed, it is possible, by performing a VPC-MS analysis, to determine the C/E ratio leading from the radical pair to the reduced product, o-dipropylbenzene (10). When this method was applied to the reaction of (Z)4-5,diethynyl-4-octene (3), C/E was found to be 0.6, independent of the concentration of 1,4-cyclohexadiene (between 0.1 and 10 M) in the chlorobenzene reaction solution. This result indicates the presence of the singlet state of 4 in the reaction of 3. Additional support for this analysis came from the reaction of 3,4-dimethyl-1,5-hexadiyn-3-ene (11) in hexachloroacetone solvent in a ^1H NMR probe. The single polarized signal (emission) observed is attributed to the major product of the reaction, 1,4-dichloro-2,3-dimethylbenzene (12), obtained by chlorine abstraction from the solvent. The interpretation of this result indicates solvent trapping of the singlet state of the intermediate 2,3-dimethyl-1,4-dehydrobenzene, consistent with the chemical trapping study. These experimental approaches indicate that at least a substantial portion of the products formed from 1,4-dehydrobenzenes at elevated temperatures arise from the singlet state of the biradical.

29090 Reaction of tert-butoxy radicals with phenols. Comparison with the reactions of carbonyl triplets. Das, P.K.; Encinas, M.V.; Steenken, S.; Scaiano, J.C. (Univ. of Notre Dame, IN). *Journal of the American Chemical Society ;* **103**: No. 14, 4162-4166(15 Jul 1981).

Tert-butoxy radicals generated in the photodecomposition of di-tert-butyl peroxide react efficiently with phenols to yield the corresponding phenoxy radicals. Typical rate constants in benzene at 22°C are 3.3 x 10^8 and 1.6 x 10^9 M^{-1} s^{-1} for phenol and p-methoxyphenol, respectively. The process is considerably slower in polar solvents; e.g., when pyridine is used as cosolvent, the rate constant for phenol drops to 4.1 x 10^6 M^{-1} s^{-1} as a result of strong hydrogen bonding which decreases the reactivity of the phenolic O-H group. Isotope effects (H/D) are typically in the 3 to 5 range. 5 figures, 4 tables.

29091 Electronic excited-state transport in random systems. Time-resolved fluorescence depolarization measurements. Gochanour, C.R.; Fayer, M.D. (Stanford Univ., CA). Contract AT03-79ER10467. *Journal of Physical Chemistry ;* **85**: No. 14, 1989-1994(9 Jul 1981).

Electronic excited-state transport in a system composed of randomly distributed molecules, i.e., rhodamine 6G in glycerol, is experimentally investigated. Time-resolved fluorescence depolarization measurements, which use a fluorescence mixing technique to give subnanosecond time resolution, provide a stringent test for theoretical work on this subject. The results yield an R_0 value of 50 A for R6G and confirm the results of the recent diagrammatic self-consistent theoretical method. Mean-square displacements and their time derivatives are reported. Energy transport is nondiffusive in the samples studied.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 28848, 29069

4005 Photochemistry

REFER ALSO TO CITATION(S) 29065

29092 (CONF-810720—3) Electron attachment as a probe of photoionization processes in liquid media. Siomos, K.; Kourouklis, G.A.; Christophorou, L.G. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 7p. NTIS, PC A02/MF A01. Order Number DE81026352.

From 2. international swarm seminar; Oak Ridge, TN, USA (22 Jul 1981).

The effects of electron attaching additives on the photoionization threshold of pyrene in seven liquid media comprising a dielectric hydrocarbon liquid and an electron attaching additive, A, were studied. The photoionization threshold, I/sub L/, was found to be independent of the dielectric hydrocarbon liquid and the con-

centration of each A used. On the basis of these data it was concluded that in the presence of an efficient A at high concentrations, the photoejected electron is captured by A at times shorter than those required for electron solvation (or any possible trapping by the solvent) and that the photoionization process for a solute molecule in these dielectric liquids is probably completed at times $\leqq 10^{-14}$ and $\geqq 10^{-16}$ s and its energetics are rather independent of the bulk properties of these liquids.

29093 **(DOE/ER/04062—T1) ELDOR investigations of radiation processes. Annual progress report, 1980-1981.** Kispert, L.D. (Alabama Univ., University (USA). Dept. of Chemistry). 1981. AS05-76ER04062. 28p. (ORO—4062-71). NTIS, PC A03/MF A01. Order Number DE81027151.

Progress reports for this period are in the following areas of study: relaxation processes; and crystal field variation. Even though it is difficult to obtain accurate relaxation times from electrospin resonance (EPR) spectra they are needed for numerous experiments. Currently one of the best ways to obtain good T_1/sub e/, T_2/sub e/ and T/sub n/ values is from spin echo measurements. This past year, electron spin echo (ESE) measurements were again carried out at Argonne National Labs to deduce T_1/sub e/, T_2/sub e/ and spin exchange rates as a function of temperatures for several model compounds. More exact and complete data due to better data handling systems were obtained from two protons undergoing hopping rotation (CH_2COO^- in zinc acetate), for two methyl groups undergoing rotational exchange ($(CH_3)_2CCOOH$ in α-aminoisobutyric acid) and for two fluorine nuclei undergoing librational motion. So far, the temperature dependence of the ESE derived relaxation times show excellent agreement with the temperature dependence deduced from ELDOR measurements. Experiments involving the effect of variable wavelength uv light on the stability and reactivity of radicals in irradiated crystals has resulted in the identification of one photo induced process and the free radicals involved. However, the progress has been slow due to difficulties with the construction of key components of the equipment required. The effort to understand solid-state polymerization in considerable detail was expanded to the study of free radical induced solid-state polymerization by diffusing gaseous electron acceptors such as AsF_5, SbF_5 or SO_3 into various crystals/powders. The free radicals intermediates in thermally polymerized phenylacetylene were identified in an effort to examine thermally produced free radicals.

29094 **(DOE/ER/10457—2) Photodecomposition of water in homogeneous solution. Progress report, August 1, 1980-October 31, 1981.** Richman, R.M. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Chemistry). 1981. Contract AS02-79ER10457. 5p. NTIS, PC A02/MF A01. Order Number DE81027214.

Irradiation at 380 nm into the lowest energy charge transfer band of $MoO_2(Et_2NCS_2)_2$ in 1,2-dichloroethane at 23°C gives $MoO_2(Et_2NCS_2)$ and (Et_2NCS_2) with a quantum yield of .0207. A subsequent radical chain reaction occurs in the dark, leading ultimately to MoO_2 and $(Et_2NCS_2)_2$. Due to these thermal reactions, a plot of loss of MoO_2 $(Et_2NCS_2)_2$ versus time shows an initial decrease followed by an increase, a behavior which is also dependent on initial concentration. We have observed the photochemistry of bis-dibenzoylmethane-dioxomolybdenum (VI), $MoO_2(DBM)_2$, at 380 nm in 1,2-dichloroethane at 23°C. The primary photoprocess is loss of ligand to form MoO_2 (DBM) and DBM.

29095 **Laser flash photolysis study of the reactions of carbonyl triplets with phenols and photochemistry of p-hydroxypropiophenone.** Das, P.K.; Encinas, M.V.; Scaiano, J.C. (Univ. of Notre Dame, IN). *Journal of the American Chemical Society ;* **103**: No. 14, 4154-4162(15 Jul 1981).

The quenching of aromatic carbonyl triplets by phenols is a very fast process for both n,π^* and π,π^* states. Representative rate constants for benzophenone triplets in benzene are 1.3 x 10^9 (phenol) and 8.1 x 10^8 (m-fluorophenol) M^{-1} s^{-1}, while for p-methoxypropiophenone the values are 4.9 x 10^9 and 5.0 x 10^9 M^{-1} s^{-1} for the same pair of substrates; 18 different phenols were examined. The rate constants are smaller in wet acetonitrile as a result of hydrogen bonding; for example for the benzophenone-phenol system we measured 8.0 x 10^7 M^{-1} s^{-1}. Isotope effects are larger for p-methoxypropiophenone than for benzophenone: for example in the case of phenol the values of k/sub H//k/sub D/ are 3.9 and 1.2, respectively (in wet acetonitrile). The quenching reaction leads to the efficient, but not quantitative, formation of phenoxy and ketyl radicals, with the only exception of p-nitrophenl where the process involves electronic energy transfer. The temperature dependence of a few representative systems, as well as the quenching by methyl ethers of similar structure, has also been examined. The photochemistry of p-hydroxypropiophenone is characterized by efficient self-quenching involving a head-to-tail hydrogen-transfer reaction.

29096 **Inhibition of photoinitiated degradation of polycarbonate by cerium(III) overcoating.** Klein, A.J.; Yu, H.; Yen, W.M. (Univ. of Wisconsin, Madison). Contract AC04-78CS35308. *Journal of Applied Polymer Science ;* **26**: No. 7, 2381-2389(Jul 1981).

Photodownconversion of UV radiation incident on a polymeric substrate, polycarbonate, into visible and IR region is effected by coating the substrate with cerous chloride ($CeCl_3$)/poly(vinyl alcohol) complex whereby photolytic degradation of the substrate is significantly inhibited. Thus it appears that cerous ion coating serves as an effective UV screener. The testing method consists of exposing the coated and naked substrate films to a medium intensity UV source with a cutoff filter below 280 nm for different intervals and determining their optical transmission characteristics. Some of the cerous ion coated films were further overcoated with polyvinyl acetate in order to prevent ion leaching by water. The final product retains the visible and IR transmittance of untreated polycarbonate film, and when the optimum composition of $CeCl_3$ in poly(vinyl alcohol) is coated, its transmission spectrum is barely changed even after 24 hr of UV irradiation. The object is to develop inexpensive solar glazing materials which can last up to 20 years without deterioration of their optical and mechanical properties upon solar irradiation.

29097 **Polarized two-photon absorption spectra of naphthalene in durene single crystal with two synchronized tunable dye lasers.** Mikami, N.; Hong, H.K. (Univ. of Notre Dame, IN). *Bulletin of the Chemical Society of Japan ;* **52**: No. 12, 3484-3495(Dec 1979).

Polarized two-photon absorption spectra of naphthalene in a single cyrstal of durene were observed with one and two beams of tunable dye lasers. Diagonal elements of the two-photon transition tensor were determined by one beam experiments with different incident polarizations on different faces of an oriented single crystal. The off-diagonal elements of the two-photon transition tensor were determined with two synchronized beams of different wavelengths and polarizations on the same sample. It was found that most of the vibronic states have large σ/sub LL/ consistent with an overall vibronic A/sub g/ symmetry and a long axis polarized ^{1}B/sub 2u/ intermediate state. The intermediate states of the two-photon process of the strongest vibronic origin have been discussed on the basis of the observed values of the two-photon transition tensor elements. The band also has a small but non-vanishing off-diagonal tensor element (σ/sub LM/). A crystal field perturbation due to reduced site symmetry by a B/sub 3g/ two-photon allowed state is postulated. 9 figures, 5 tables.

29098 **Infrared photolysis of SO_2.** Bialkowski, S.E.; Guillory, W.A. (Univ. of Utah, Salt Lake City). Contract ER-78-S-02-4695. *Chemical Physics Letters ;* **60**: No. 3, 429-430(15 Jan 1979).

Visible luminescence observed from the IR photolysis of SO_2 between 2 and 25 torr appears to be the result of the SO_2 afterglow. These results suggest the first possible IR photolysis of a triatomic molecule via collisional pumping.

4006 Radiation Chemistry

REFER ALSO TO CITATION(S) 28267, 29015, 29093, 29307

29099 **γ-radiolysis of aqueous benzo[b]thiophene solutions.** Feng, P.Y. (Marquette Univ., Milwaukee, WI); Patel, K.; Kaplan, L.; Matheson, M.S. *Journal of Physical Chemistry ;* **85**: No. 14, 2098-2103(9 Jul 1981).

γ-radiolysis of aqueous benzo[b]thiophene solutions saturated with N_2O has been studied. In the absence of other reagents, the only products detected are 2- and 3-hydroxybenzothiophene and their corresponding lactonic and ketonic tautomers and a small amount of dimeric species. In the presence of potassium hexacyanoferrate or sodium hydroxide, however, products attributable to hydroxylation at all six available carbon sites are detected and dimer formation is reduced. Analysis of the experimental data suggests that both benzohiophene and its hydroxylation products are efficient scavengers for the radiation-produced OH radicals and that the initial yield of hydroxylation products is equal to that of hydroxyl radicals. Consistent with the electrophilic characteristics of the OH radical, $k(OH + C_8H_6):k(OH + C_8H_5SOH) = 0.5 +- 0.1$. All six available carbon sites are capable of forming OH adducts, but the radicals formed by addition to the 4, 5, 6, and 7 positions tend to revert to the original compound or its ion in a neutral or acidic medium. In the case of the adducts formed by addition to the thiophene ring, on the other hand, the 3 position is seen to be favored, possibly as the result of the preservation of the aromatic benzene resonance structure.

29100 **One-electron oxidation of chlorophyll a and (tetraphenylporphyrinato)cobalt(II) by various metalloporphyrin cation radicals. Kinetic spectrophotometric studies.** Neta, P.; Grebel, V.; Levanon, H. (Univ. of Notre Dame, Indiana). *Journal of Physical Chemistry ;* **85**: No. 14, 2117-2118(9 Jul 1981).

One-electron oxidations of various metalloporphyrins in dichloroethane solutions were studied by kinetic spectrophotometric pulse radiolysis. Co/sup II/TPP (TPP = tetraphenylporphyrin) was found to produce Co/sup III/TPP while the Cd(II), Cu(II), Pb(II), and VO complexes, like the ZnTPP and MgTPP, yield the cation radicals. Ni/sup II/TPP is oxidized at the metal center in the presence of pyridine but at the ligand in its absence. The subsequent one-electron oxidation of chlorophyll a and Co/sup II/TPP by the above cation radicals was also followed. The rate constants for these reactions were found to be mostly in the range of 3×10^8-5×10^8 $M^{-1} s^{-1}$, much lower than the expected diffusion-controlled rates.

29101 **ESR study of hydrogen-bombarded 9-methyladenine.** Lee, J.Y.; Bernhard, W.A. (Univ. of Rochester, NY). Contract AC02-76EV03490. *Radiation Research ;* **86**: No. 2, 287-293(May 1981).

The damage in 9-methyladenine resulting from discharge-generated hydrogen atoms is compared with the damage from ionizing radiation. It is concluded that: (1) hydrogen abstraction from the methyl occurs as a result of X irradiation but not H bombardment, (2) hydrogen addition occurs at C8 but not C2 as a result of H bombardment, and (3) the radical characterized by an ESR singlet, formed by X irradiation and H bombardment, is due to hydrogen addition to the C4-C5 aromatic bond.

29102 **Bibliographies on radiation chemistry: introduction to the series.** Schuler, R.H.; Ross, A.B.; Helman, W.P. (Notre Dame Univ., IN (USA). Radiation Lab.). *Radiation Physics and Chemistry ;* **17**: No. 1, 3-4(1981).

The availability of a computer searchable bibliographic data base (RCDCbib) on radiation chemistry has prompted the initiation in Radiation Physics and Chemistry of a series of topical bibliographies derived from that data base. Content, structure, programs for searching and various possible uses of the data base have been previously described. Here are briefly discussed guidelines under which this series has been conceived, certain limitations that can be expected and auxiliary information which will be available from the Radiation Chemistry Data Center. The first in this series, a bibliography of studies of the heavy particle radiolysis of liquids and aqueous systems, provides an illustrative example.

29103 **Bibliographies on radiation chemistry. 1. Studies of the heavy particle radiolysis of liquids and aqueous solutions.** LaVerne, J.A.; Schuler, R.H.; Ross, A.B.; Helman, W.P. (Notre Dame Univ., IN (USA). Radiation Lab.). *Radiation Physics and Chemistry ;* **17**: No. 1, 5-20(1981).

The list of 390 references covers papers on the heavy particle radiolysis of liquids and aqueous solutions, including work with alpha particles, which have appeared through March 31, 1980. The list includes only papers on (1) pure water and solutions of inorganic solutes and (2) organic solutes, (3) liquids other than water, (4) theoretical treatments and (5) reviews. The latter two categories contain papers which detail general aspects of heavy ion radiolysis or track theory.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 29132

29104 **(DOE/ET/41900—7) Crystal chemistry of some monazite-structured phosphates and silicates.** Pepin, J.G.; Davis, D.D.; McCarthy, G.J.; Vance, E.R. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). 30 Jun 1981. Contract AC09-79ET41900. 37p. (ESG-DOE—13351). NTIS, PC A03/MF A01. Order Number DE81028554.

$Ca_{0.5}U_{0.5}PO_4$ can be synthesized phase-pure in a neutral atmosphere or a closed system at about 1200°C by ceramic techniques, and it forms complete solid solutions with $Ca_{0.5}Th_{0.5}PO_4$ and $NdPO_4$. Uranium appears to occur in monazite essentially in only the tetravalent state. The possible role of some other ions in monazite was also studied. Monazite prepared at 1200°C in air was observed to incorporate cerium as 3+ and not 4+ even when charge compensation mechanisms for Ce^{4+} inclusion were present. The consequences of this phenomenon for the use of monazite structure-type solid solutions for transuranic nuclide isolation in radioactive waste management are discussed. We could not prepare $CeSiO_4$ by conventional ceramic techniques, hydrothermal treatment at 700°C, or precipitation. The use of cerium as a substitute for the actinides is also considered. Unit cell constants for $REPO_4$ (RE = La to Gd) have been redetermined. Nine-fold coordinated ionic radii for Pu^{3+}, Am^{3+}, and Cm^{3+} in the monazite structure type have been calculated.

29105 **(DP-MS—81-17) Separation of ^{241}Am from calcium, lead, and certain other metallic impurities.** Gray, L.W.; Burney, G.A.; King, C.M. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1981. Contract AC09-76SR00001. 29p. (CONF-810813—9). NTIS, PC A03/MF A01. Order Number DE81027496.

From National American Chemical Society summer meeting; New York, NY, USA (23 Aug 1981).

During the decade of the 1970's, the Savannah River Plant (SRP) became a major supplier of ^{241}Am to the Isotope Sales Program of the Department of Energy for use in the preparation of low-gamma background neutron sources useful in petroleum well logging. Contaminants which have been troublesome to the SRP processes have included Ca, Pb, Fe, Cr, Ni, Al, Mg, and Pu. As part of an overall program to upgrade SRP processes, a variety of separation techniques were studied in an effort to arrive at a generic process which would yield both high recovery of ^{241}Am, > 95%, and high purity, > 98% $^{241}AmO_2$. Processes studied with and without prior contaminant complexes include solvent extraction, ion exchange, and precipitation. Flowsheets that can be optimized either on processing time or waste generation and that yield a desirable percent recovery and desirably pure product were developed.

29106 **(K/ET—604) Vapor pressure measurements on UF_4: an analysis.** Leitnaker, J.M. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 27 May 1981. Contract W-7405-ENG-26. 38p. NTIS, PC A03/MF A01. Order Number DE81027684.

Literature data for the vaporization behavior of UF_4 have been tabulated and analyzed. Both the solid and the liquid vaporize congruently to a monomeric molecule. The data with the highest precision (Hildenbrand for the solid and Langer and Blankenship for the liquid) yield values for the enthalpy of fusion which are in accord with the measured enthalpy of fusion - and within the errors of all the other measurements. Selected thermodynamic values for the vaporization of UF_4, both solid and liquid, are tabulated in Table 12.

29107 (ORNL/TM—7775) Nuclear medicine technology progress report for quarter ending March 31, 1981. Knapp, F.F. Jr. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 20p. NTIS, PC A02/MF A01. Order Number DE81027080.

A new synthetic procedure was developed for the preparation of terminally halogenated selenium and tellurium long-chain fatty acids. Since the Se and Te fatty acids have been shown to exhibit prolonged uptake in the myocardium, this synthesis was developed to prepare the radiohalogenated agents for evaluation in animal studies. The model ^{131}I-labeled agent, ^{131}I-17-iodo-9-THDA, was also prepared and evaluated in rats. Tissue distribution studies with ^{131}I-17-iodo-9-THDA indicated only moderate heart uptake after 2 to 30 min. In addition, the radioactive contents of the heart fell rapidly after administration of the radioiodinated agent. These data appear to indicate significant in vivo deiodination. Parallel studies with ^{131}I-16-iodopalmitic acid demonstrated that heart uptake and deiodination were similar for the two radioiodinated agents. Synthetic efforts will now be directed at developing techniques for introduction of terminal functional groups to which halogens will form strong bonds to minimize the dehalogenation.

29108 (PNL—3846) Strontium-90 fluoride data sheet. Fullam, H.T. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1981. Contract AC06-76RL01830. 71p. NTIS, PC A04/MF A01. Order Number DE81027834.

This report is a compilation of available data and appropriate literature references on the properties of strontium-90 fluoride and nonradioactive strontium fluoride. The objective of the document is to compile in a single source pertinent data to assist potential users in the development, licensing, and use of $^{90}SrF_2$-fueled radioisotope heat sources for terrestrial power conversion and thermal applications. The report is an update of the Strontium-90 Fluoride Data Sheet (BNWL-2284) originally issued in April 1977.

29109 Actinide-carbon ' bonds: insertion reactions of carbon monoxide, tert-butyl isocyanide, and tert-butyl cyanide into $[(Me_3Si)_2N]_2MCH_2Si(Me)_2NSiMe_3$. Simpson, S.J.; Andersen, R.A. (Univ. of California, Berkeley). Contract W-7405-ENG-48. *Journal of the American Chemical Society ;* **103**: No. 14, 4063-4066(15 Jul 1981).

The thorium or uranium metallacycles $[(Me_2Si)_2N]_2M CH_2Si(Me)_2NSiMe_3$ (I) react with tert-butyl cyanide to give the six-membered ring compounds $[(Me_3Si)_2N]_2MN = C(t\text{-}Bu)CH_2Si(Me)_2NSiMe_3$. The metallacycles (I) also react with the isoelectronic molecules tert-butyl isocyanide and carbon monoxide to give the unique five-membered ring compounds with exocyclic carbon-carbon double bonds, $[(Me_3Si)_2N]_2M XC(=CH_2)Si(Me)_2NSiMe_3$, where X is t-BuN or oxygen. The four-membered ring metallacycles (I) give simple coordination complexes of the type $[(Me_3Si)_2N]_2MCH_2Si\text{-}(Me)_2NSiMe_3(N_3SiMe_3)$ with trimethylsilyl azide.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

29110 (DOE/PC/30247—T1) Soot formation from polycyclic aromatics. Technical progress report, September 1, 1980-February 28, 1981. Frenklach, M. (Louisiana State Univ., Baton Rouge (USA)). Mar 1981. Contract FG22-80PC30247. 31p. NTIS, PC A03/MF A01. Order Number DE81025504.

The initial phase of this study has been focused on determining the accuracy of the absolute values of soot conversion and the reliability of the experimental techniques employed to determine soot formation from polycyclic aromatics in various shock tube experiments. The LSU experimental results have demonstrated consistency between the present observations and results reported by other research groups, thus eliminating the controversies suggested by a number of researchers. Analysis of the preliminary experimental data has resulted in the postulation of a new conceptual mechanistic model for soot formation from polycyclic aromatics. Preliminary analysis using the model offers an explanation of various experimental trends. Additional work with this conceptual model may subsequently lead to a more systematic approach for determination and classification of the soot formation data.

29111 (NRL-MR—4570) Lagrangian fluid dynamics for combustion modelling. Fritts, M.J.; Oran, E.S.; Boris, J.P. (Naval Research Lab., Washington, DC (USA)). 21 Jul 1981. 45p. NTIS, PC A03/MF A01. Order Number DE81027831.

Recent flow visualization experiments have shown the need to follow the behavior of dynamically interacting coherent structures in both cold flows and flames. Since these structures move with the fluid, a Lagrangian approach is especially useful in theoretical calculations because we can observe the interaction of a particular fluid element with its changing environment as the flow evolves. One-dimensional Lagrangian flame models are successful because they also minimize the effects of numerical diffusion which is the bane of laminar flame calculations. However, most two- and three-dimensional flame models are Eulerian because of problems in standard Lagrangian formulations for multi-dimensional models and because phenomenological turbulent diffusion terms are usually added which mask the numerical diffusion. This paper describes one- and multi-dimensional Lagrangian algorithms which eliminate many of the problems previously associated with this approach. An example of a one-dimensional flame calculation which incorporates the new ideas are given. Finally, examples are given of the two-dimensional Lagrangian triangular gridding technique and it will be indicated how this may be applied to multi-phase combustion problems.

29112 Laser-induced fluorescence: a powerful tool for the study of flame chemistry. Muller, C.H. III; Schofield, K.; Steinberg, M. (Univ of Calif, Santa Barbara). *ACS (American Chemical Society) Symposium Series ;* No. 134, 103-130(1980). (CONF-790917—).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

Laser-induced fluorescence is employed in a study of the chemistry of sulfur in rich hydrogen/oxygen/nitrogen flames, and a simple rationale is shown for taking quench effects into account. Fluorescence measurements for S/sub 2/, SH, SO/sub 2/, SO, and OH, along with measurements of flame temperature and H-atom (in sulfur-free flames), have been employed to develop a kinetic model for the highly coupled flame chemistry of sulfur. 20 refs.

29113 Electron collision quenching of CO(v) chemiluminescence in CS_2/O_2 and $CS_2/O_2/N_2O$ flames. Kushner, M.J.; Grossman, W.M.; Culick, F.E.C. (Sandia National Laboratories, Albuquerque, New Mexico 87185, and the California Institute of Technology, Pasadena, California 91125). *Journal of Applied Physics ;* **52**: No. 6, 3776-3779(Jun 1981).

Chemiluminescence from vibrationally excited carbon monoxide formed by the reaction $CS+O\rightarrow CO(v)+S$ was observed in CS_2/O_2 and $CS_2/O_2/N_2O$ flames to which an electric discharge was applied. Although the total amount of chemiluminescence increased with increasing discharge current probably due to enhanced reaction rates as a result of radical formation, the vibrational distribution was quenched, becoming thermal in character. The thermalization is attributed to superelastic electron collisions $[e+CO(v)\rightarrow e+CO(v\text{-}1)]$. The technique demonstrates a sensitive method for detecting collisional transfers between excited states by separating the perturbation (electron collisions) from the initial excitation mechanism (chemical reactions).

29114 Saturated-fluorescence measurements of the hydroxyl radical. Lucht, R.P.; Sweeney, D.W.; Laurendeau, N.M. (Purdue Univ, West Lafayette, Indiana). *ACS (American Chemical Society) Symposium Series ;* No. 134, 145-151(1980). (CONF-790917—).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

The OH radical has been selected for preliminary saturated molecular fluorescence studies. A Nd:YAG pumped dye laser is used to excite an isolated rotational transition, and the resulting fluorescence signal is analyzed both spectrally and temporally in order to study the development of the excited-state rotational distribution. It is found that steady state is not established throughout the upper rotational levels, although the directly excited upper rotational level remains approximately in steady state during the laser pulse.

The fluorescence signal from the directly excited upper level exhibits considerable saturation. A molecular fluorescence model is presented which is particularly appropriate for short pulse excitation. 9 refs.

29115 **Nitric oxide detection in flames by laser fluorescence.** Grieser, D.R.; Barnes, R.H. (Battelle, Columbus Lab, Ohio). *ACS (American Chemical Society) Symposium Series ;* No. 134, 153-158(1980). (CONF-790917—).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

It is demonstrated that laser fluorescence can be used to detect NO in atmospheric-pressure flames. The method described is based on the use of a frequency-doubled tunable dye laser to excite transitions in the (0,0) /gamma/-band of NO in the range of 2250 to 2270 A. Fluorescence was observed at wavelengths associated with the bands involving the (0,0), (0,1), (0,2), and higher ground-state vibrational transitions of the /gamma/-band system. Detection sensitivities in the ppm range were observed with laser pulse energies in the range of about 3 /mu/J. This sensitivity can be increased significantly by using a higher intensity laser. 3 refs.

29116 **Raman-scattering measurements of combustion properties.** Lapp, M. (GE, Schenectady, NY). *ACS (American Chemical Society) Symposium Series ;* No. 134, 207-230(1980). (CONF-790917—).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

The advantages and limitations of various potential, light-scattering laser probes are discussed. These are illustrated with recent results of vibrational Raman scattering flame diagnostics. 24 refs.

29117 **Temperature-velocity correlation measurements for turbulent diffusion flames from vibrational raman-scattering data.** Warshaw, S.; Lapp, M.; Penney, C.M.; Drake, M.C. (GE, Schenectady, NY). *ACS (American Chemical Society) Symposium Series ;* No. 134, 239-246(1980). (CONF-790917—).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

Preliminary results for the (temperature * velocity) probability density function are presented where the quantities are instantaneous values. These data have been obtained from a coordinated experimental program utilizing pulsed laser vibrational Raman scattering and cw real fringe laser velocimetry. These instantaneous temperature and velocity values can be related to values of the average fluctuating mass flux </rho/'u'> for the experimental conditions, utilizing assumptions of the ideal gas law and fast flame chemistry. Here /rho/' and u' are fluctuation values of density and velocity, respectively, Knowledge of flame properties such as <p'u'> provides key data needed for developing improved combustion models. 9 refs.

29118 **Absorption spectroscopy of combustion gases using a tunable IR diode laser.** Hanson, R.K.; Varghese, P.L.; Schoenung, S.M.; Falcone, P.K. (Stanford Univ, Calif). *ACS (American Chemical Society) Symposium Series ;* No. 134, 413-426(1980). (CONF-790917—).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

Diode laser techniques as applied to a flat flame burner and to a room temperature absorption cell are discussed. The cell experiments are used to determine the absorption band strength which is needed to properly interpret high temperature experiments. Preliminary results are reported for CO concentration measurements in a flame, the fundamental band strength of CO at STP, collision halfwidths of CO under flame conditions, and the temperature dependence of CO and NO collision halfwidths in combustion gases. 12 refs.

29119 **Temperature measurement in turbulent flames via Rayleigh scattering.** Dibble, R.W.; Hollenbach, R.E.; Rambach, G.D. (Sandia Lab, Livermore, Calif). *ACS (American Chemical Society) Symposium Series ;* No. 134, 435-441(1980). (CONF-790917—).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

Temperature measurements were made with the use of laser Rayleigh scattering on a turbulent jet diffusion flame with a frequency response, DC-5 kHz, unachievable by any other present-day laser-based technique. The flame reactants and products had nearly equal Rayleigh scattering cross sections so that the temperature could be inferred directly from the scattering intensity from a point on a probe laser beam. Probability densities, means, higher moments, and power spectrum are generated from the time series of temperatures. 14 refs.

29120 **Applications of optical diagnostic techniques in combustion research.** Hartley, D.L.; Gusinow, M.A. (Sandia Lab, Livermore, Calif). *AGARD Conference Proceedings ;* No. 281, 21.1-21.5(1980). (CONF-8005178—).

From 55. specialists' meeting of the AGARD propulsion and energetics panel; Brussels, Belgium (5 May 1980).

The paper presents a summary of the application of laser-based optical techniques to the diagnostics of combustion problems. Emphasis is placed on the determination of temperature and species concentrations in a combusting environment. The application of these techniques has centered on laminar flames, turbulent flames, particulate-laden flows, and internal combustion engines. 19 refs.

29121 **Chemical kinetic modelling for combustion application.** Dryer, F.L.; Westbrook, C.K. (Princeton Univ, NJ). *AGARD Conference Proceedings ;* No. 275, 14.1-14.17(1980). (CONF-7910235—).

From 54. specialists' meeting of the AGARD propulsion and energetics panel; Cologne, F.R. Germany (3 Oct 1979).

Results of a systematic program designed to produce kinetic models for practical fuels are discussed. The program has two principal goals: the construction of detailed reaction mechanisms for the oxidation of typical hydrocarbon fuels, and the validation of these mechanisms through careful comparisons between computed and experimental data. These mechanisms are strongly hierarchical, with reactions for complex fuels containing subsets which describe the combustion of chemically simpler fuels. Progress to date includes relatively complete descriptions of carbon monoxide, hydrogen, methane, ethane, and methanol oxidation. In the development and verification of these reaction mechanisms attempts are made to use data from a variety of experimental sources, including flow reactor techniques at intermediate temperatures (900-1300°K) and shock tube results for high temperatures (1300-2200/degree/K). 22 refs.

29122 **On the near-ignition stability of diffusion flames.** Matalon, M.; Ludford, G.S.S. (Polytech Inst of NY, Farmingdale). *International Journal of Engineering Science ;* **18**: No. 8, 1017-1026(1980).

Activation-energy asymptotics enable steady combustion states not only to be determined but also to be examined for stability. Here the S-response of a diffusion flame in a chamber is considered, in particular the top bend corresponding to ignition. The upper branch is found to be stable and the middle branch unstable, the neutral point lying exactly at the bend. 16 refs.

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4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 28099, 28100, 28101, 28212, 28273, 29149, 29672, 29720

29123 (CONF-801038—(Vol.2), pp 1142-1164) **Investigation of air cleaning system response to accident conditions.** Andrae, R.W. (Los Alamos Scientific Lab., NM); Bolstad, J.W.; Foster, R.D.; Gregory, W.S.; Horak, H.L.; Idar, E.S.; Martin, R.A.; Ricketts, C.I.; Smith, P.R.; Tang, P.K. Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

We are investigating air cleaning system response to the stress of accident conditions. In this paper we present a program

overview and highlight recent results of our investigations. The program includes both analytical and experimental investigations. Computer codes for predicting effects of tornados, explosions, fires, and material transport are described. We also describe the test facilities we use to obtain supportive experimental data to define structural integrity and confinement effectiveness of ventilation system components. Examples of experimental results for code verification, blower response to tornado transients, and filter response to tornado and explosion transients are reported.

29124 **(CONF-8006139—2) SQUIDS and their sensitivity for geophysical applications.** Falco, C.M.; Schuller, I.K. (Argonne National Lab., IL (USA)). Jun 1980. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01. Order Number DE81023419.

From Squid applications to geophysics workshop; Los Alamos, NM, USA (2 Jun 1980).

Superconducting Quantum Interference Devices (SQUIDs) have been extensively studied over the last decade and a half. They have been developed to a point where a variety of measurements are now possible with a sensitivity that wasn't considered feasible 15 years ago. This paper reviews the physical principle behind the operation of these devices. Our intention is to enable the reader with limited familarity with superconductivity to understand their basic operation, as well as to understand their sensitivity and potential for further development.

29125 **(CONF-8106101—1) Liquid-particle dynamics and rate of evaporation in the rotating field of centrifugal compressors.** Pinkus, O. (Mechanical Technology, Inc., Latham, NY (USA)). 1981. Contract W-7405-ENG-26. 42p. NTIS, PC A03/MF A01. Order Number DE81024075.

From Symposium on energy and environment, turbomachinery technology; Patras, Greece (22 Jun 1981).

A model is presented which consists of injecting a liquid coolant into the vapor of centrifugal compressors via slots in the rotating blades. The aim of the injection is to achieve isothermal compression and thus minimal work input. The 3-dimensional analysis determines the relative velocities and trajectories of the liquid particles, and their rate of vaporization as a function of the prevailing flow field and inlet conditions. Inertia, viscous drag, centrifugal and Coriolis forces are all included. The computer-obtained results show that for optimum conditions and to avoid collision with the blades it is desirable that injection occur at the suction side of the blades and close to the hub; that low rather than high initial particle velocities are preferred; and that small droplet sizes are required both to avoid blade erosion and to assure the highest rate of vaporization. The analysis also shows that vaporization levels will remain low unless the compressed vapor is at relatively high temperatures.

29126 **(DOE/ET/33009—T13) Selenide isotope generator for the Galileo Mission. Axially-grooved heat pipe: accelerated life test results.** (Teledyne Energy Systems, Timonium, MD (USA)). Aug 1979. Contract AC03-78ET33009. 50p. NTIS, PC A03/MF A01.

The results through SIG/Galileo contract close-out of accelerated life testing performed from June 1978 to June 1979 on axially-grooved, copper/water heat pipes are presented. The primary objective of the test was to determine the expected lifetime of axially-grooved copper/water heat pipes. The heat pipe failure rate, due to either a leak or a build-up of non-condensible gas, was determined. The secondary objective of the test was to determine the effects of time and temperature on the thermal performance parameters relevant to long-term ($>$ 50,000 h) operation on a space power generator. The results showed that the gas generation rate appears to be constant with time after an initial sharp rise although there are indications that it drops to approximately zero beyond $\sim$ 2000 h. During the life test, the following pipe-hours were accumulated: 159,000 at 125°C, 54,000 at 165°C, 48,000 at 185°C, and 8500 at 225°C. Heated hours per pipe ranged from 1000 to 7500 with an average of 4720. Applying calculated acceleration factors yields the equivalent of 930,000 pipe-h at 125°C. Including the accelerated hours on vendor tested pipes raises this number to 1,430,000 pipe-hours at 125°C. It was concluded that, for a heat pipe temperature of 125°C and a mission time of 50,000 h, the demonstrated heat pipe reliability is between 80% (based on 159,000 actual pipe-h at 125°C) and 98% (based on 1,430,000 accelerated pipe-h at 125°C). Measurements indicate some degradation of heat transfer with time, but no detectable degradation of heat transport. (LCL)

29127 **(HEDL-SA—1231-FP) Design features and objectives of the Fuels and Materials Examination Facility.** Doman, D.R.; Trego, A.L.; Burgess, C.A. (Westinghouse Hanford Co., Richland, WA (USA)). 15 Jun 1977. Contract AC14-76FF02170. 25p. (CONF-771109—115). NTIS, PC A02/MF A01. Order Number DE81027579.

From ANS winter meeting; San Francisco, CA, USA (27 Nov 1977).

The conceptual design has been nearly completed on the FMEF, a hot cell facility for destructive and nondestructive examination of irradiated fuels and materials tested in the Fast Flux Test Facility (FFTF) and other breeder reactors. The FMEF will be constructed near the FFTF and is scheduled to be operational by early 1983. A large cell with 22 work stations permits nondestructive examinations of full assemblies and pins while 12 smaller cells provide sectioning of failed assemblies or pins and destructive examinations. These cells contain a recirculating nitrogen atmosphere. To handle the large assemblies and increased number of fuels and materials specimens irradiated in the FFTF, the facility is highly mechanized to provide high throughput.

29128 **(LA-UR—81-909) Performance predictions and measurements for space-power-system heat pipes.** Prenger, F.C. Jr. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 16p. (CONF-810902—1). NTIS, PC A02/MF A01.

From Heat pipe conference; London, UK (7 Sep 1981).

High temperature liquid metal heat pipes designed for space power systems have been analyzed and tested. Three wick designs are discussed and a design rationale for the heat pipe is provided. Test results on a molybdenum, annular wick heat pipe are presented. Performance limitations due to boiling and capillary limits are presented. There is evidence that the vapor flow in the adiabatic section is turbulent and that the transition Reynolds number is 4000.

29129 **(LA-UR—81-969) Performance limits of gravity-assist heat pipes with simple wick structures.** Prenger, F.C. Jr.; Kemme, J.E. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 10p. (CONF-810902—3). NTIS, PC A02/MF A01.

From Heat pipe conference; London, UK (7 Sep 1981).

Experiments using gravity-assist heat pipes with simple wick structures were used to establish performance limits due to entrainment of the liquid by the counterflowing vapor. A physical model is postulated which leads to a single correlation predicting entrainment limits for all data investigated. The characteristic length in the entrainment parameter is the depth of the wick structure and the model infers an upper bound on this parameter.

29130 **(LA-UR—81-1414) Heat-pipe development for high-temperature recuperator application.** Merrigan, M.; Dunwoody, W.; Lundberg, L. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 14p. (CONF-810902—4). NTIS, PC A02/MF A01.

From Heat pipe conference; London, UK (7 Sep 1981).

Heat pipes have been developed for operation in oxidizing atmospheres at temperatures above 1100°K. The heat pipes comprise a metallic liner and wick structure with a protective outer shell of an oxidation resistant material. The working fluids used in the heat pipes are alkali metals. A number of configurations have been evaluated, ranging from pipes using a metallic inner liner of a chemically vapor deposited (CVD) refractory metal applied to ceramic tubing, to one utilizing ferrous materials with an outer layer of a developed oxide. A promising intermediate configuration consisting of free-standing refractory tubing covered with a layered structure of fine grain, equi-axed CVD silicon carbide has also been evaluated. The test heat pipe was fabricated using low-carbon, arc-cast molybdenum tubing and a wick composed of 150 mesh molybdenum screen. Hafnium gettering was used with sodium working fluid. Assembly of the pipe was by electron beam welding. Following closure and capping of the fill tube the assembly was operated in a vacuum for several hours prior to the chemical vapor deposition of the exterior ceramic coating. After coating, the pipe was operated in air and in combustion gases for performance evaluation.

The use of iron-chromium-aluminum alloys as container materials for operating in high temperature oxidizing and sulfiding gas streams has been investigated. Alloys of this type develop heavy, protective oxide surface layers when exposed to high temperature oxidizing atmospheres, and are commonly used in electrical heating elements because of their exceptional oxidation resistance.

29131 **(LA-UR—81-1883) Rail gun development for EOS research.** Fowler, C.M.; Peterson, D.R.; Hawke, R.S.; Brooks, A.L. (Los Alamos National Lab., NM (USA); Lawrence Livermore National Lab., CA (USA)). 1981. Contract W-7405-ENG-36. 6p. (CONF-810684—34). NTIS, PC A02/MF A01. Order Number DE81025342.

From APS conference on shock waves in condensed matter; Menlo Park, CA, USA (23 Jun 1981).

The status of a railgun program for EOS research in progress at Los Alamos and Livermore National Laboratories is described. The operating principle of rail guns, the power supplies used to drive them, diagnostic techniques used to monitor their performance and initial efforts to develop projectiles suitable for EOS research are discussed. (WHK)

29132 **(PNL—3660) Benefits of explosive cutting for nuclear-facility applications.** Hazelton, R.F.; Lundgren, R.A.; Allen, R.P. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1981. Contract AC06-76RL01830. 77p. NTIS, PC A05/MF A01. Order Number DE81028256.

The study discussed in this report was a cost/benefit analysis to determine: (1) whether explosive cutting is cost effective in comparison with alternative metal sectioning methods and (2) whether explosive cutting would reduce radiation exposure or provide other benefits. Two separate approaches were pursued. The first was to qualitatively assess cutting methods and factors involved in typical sectioning cases and then compare the results for the cutting methods. The second was to prepare estimates of work schedules and potential radiation exposures for candidate sectioning methods for two hypothetical, but typical, sectioning tasks. The analysis shows that explosive cutting would be cost effective and would also reduce radiation exposure when used for typical nuclear facility sectioning tasks. These results indicate that explosive cutting should be one of the principal cutting methods considered whenever steel or similar metal structures or equipment in a nuclear facility are to be sectioned for repair or decommissioning. 13 figures, 7 tables. (DLC)

29133 **(SAND—81-0141) Development report for contact-handled waste container and handling system.** Dunn, L.A. (Sandia National Labs., Albuquerque, NM (USA)). May 1981. Contract AC04-76DP00789. 39p. NTIS, PC A03/MF A01. Order Number DE81027478.

This report describes the development of a container system for contact-handled radioactive waste. One waste package is a six-pack of commonly used 55-gallon drums. The other container is a rectangular metal box sized to just accomodate six 55-gallon drums. Both packages are equipped with lifting brackets so that the packages can be conveniently manipulated with a specially-designed lifting adaptor placed on a standard forklift. 16 figures, 3 tables.

29134 **(SAND—81-1720C) Testing of a cornering water-jet-drilling system for drilling horizontal holes in coal.** Love, S.L.; Timmerman, K.M. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 5p. (CONF-810923—5). NTIS, PC A02/MF A01. Order Number DE81027603.

From 7. underground coal conversion symposium; Fallen Leaf Lake, CA, USA (8 Sep 1981).

Sandia National Laboratories is developing a drilling system which uses high pressure water jets to drill horizontal holes in a coal seam which is accessed through a vertical borehole. These horizontal holes can be drilled for the purpose of draining methane before mining begins or for creating linkage paths between vertical boreholes in a linked vertical well underground coal gasification process. In two years of work, the elements of the water jet drill which have been developed and tested are the drilling head, an articulated drill string, and an instrumentation system for directional control and hole mapping. In the most recent field tests, six to eight inch diameter holes of up to 102 feet long were drilled into a coal seam accessed at the face of a surface mine pit. A quarter scale laboratory model of the cornering device has been built and tested to evaluate the design, and hardware is being built for the full scale version. Tests of the complete round-the-corner system will be performed later this year.

29135 **(TAC-HP—81-002) Heat-pipe technology: a bibliography with abstracts. Quarterly update, April-June 1981.** Srinivasan, R.; Feldman, K.T. Jr. (eds.). (New Mexico Univ., Albuquerque (USA). Technology Application Center). Jul 1981. 69p. Univ. of New Mexico, Technology Application Center, Albuquerque. Order Number DE81903608.

A bibliography of 93 publications on heat pipes is presented. The citations are arranged by categories of general information and heat pipe uses, theory, design, fabrication, and performance. An author index and title/keyword index are provided. Five heat-pipe related patents are listed. (LCL)

29136 **Reply to "Comment on 'The general critical state model in two dimensions and zero applied field: A uniqueness theorem and some consequences' ".** Migliori, A.; Beyer, W.A.; Milton Wing, G. (Los Alamos Scientific Laboratory, P. O. Box 1663, Los Alamos, New Mexico 87545). W-7405-ENG.36. *Journal of Applied Physics ;* **52**: No. 6, 4333(Jun 1981).

The comment by Baixeras et al. [J. Appl. Phys. 52, 4330 (1981)] on the recent paper by Migliori [J. Appl. Phys. 51, 3439 (1980)] utilizes counterexamples not consistent with Migliori's premise. Baixeras et al. also fail to support their contention that in two dimensions it is possible, if more difficult, to solve a general critical state model with boundary conditions.

29137 **Behaviour of power leads for superconducting magnets.** Aharonian, G.; Hyman, L.G.; Roberts, L. (Argonne National Lab., IL (USA)). *Cryogenics ;* **21**: No. 3, 145-151(Mar 1981).

Data required in designing power leads for superconducting magnets to obtain optimum behaviour are presented, including, in particular, details of the performance of leads operating away from optimum conditions, comparisons between ideal cooling and a realistic model for gas cooling, and properties of gas-cooled leads on loss of coolant.

29138 **Worldwide cryogenics - US. Cryogenics at the Los Alamos Scientific Laboratory.** Keller, W.E. (Los Alamos Scientific Lab., NM (USA)). *Cryogenics ;* **20**: No. 10, 547-557(Oct 1980).

A brief history is given of the involvment of the Los Alamos Scientific Laboratory (LASL) in cryogenic research since initial work on weapons. This is followed by an outline of the Laboratory's current activities including: low temperature physics, superconducting power transmission, superconducting magnetic energy storage, Tokamak poloidal field systems, SQUID applications, tritium systems for Tokamaks, liquid hydrogen fuelled vehicles, and magnetic refrigeration.

29139 **Strain gauges for superconducting magnet testing.** Walstrom, P.L. (Oak Ridge National Lab., TN (USA)). *Cryogenics ;* **20**: No. 9, 509-512(Sep 1980).

A survey of commercially available strain gauges potentially suitable for testing of superconducting magnets is presented. Strain measurement errors caused by magnetic fields and temperature changes are discussed. Previously unpublished data for the magnetic field-induced error for weldable half-bridge strain gauges are given, along with the results of a test for the temperature dependence of the magnetoresistance of modified Karma alloy foil gauges in the liquid helium temperature range. Apparent strain-vs-temperature curves for the weldable half-bridge gauges and metal foil gauges are shown. Errors caused by magnetic fields are, in general, repeatable from gauge to gauge, whereas errors due to temperature effects exhibit considerable variation from gauge to gauge in many nominally identical gauges.

29140 Shockless airfoils for wings, compressors, and turbines. Garabedian, P.R. (New York Univ., NY). Contract EY-76-C-02-3077. pp 139-149 of Nonlinear partial differential equations in engineering and applied science. Sternberg, R.L.; Kalinowski, A.J.; Papadakis, J.S. (eds.). New York, NY; Marcel Dekker, Inc. (1980).

The use of nonlinear partial differential equations for determining the aerodynamic characteristics of airfoils in subsonic and transonic flow is discussed. Experimental data on drag coefficients and pressure distribution for flow velocities up to Mach 0.753 are compared. (LCL)

4203 Lasers

REFER ALSO TO CITATION(S) 29115, 29670

29141 (LA-UR—81-1936) Two-dimensional theory and simulation of free electron lasers. Kwan, T.J.T.; Cary, J.R. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 9p. (CONF-810620—7). NTIS, PC A02/MF A01. Order Number DE81025365.

From 4. international topical conference on high-power electron and ion-beam research and technology; Palaiseau, France (29 Jun 1981).

Two-dimensional homogeneous theory of free-electron lasers with a wiggler magnetic field of constant wavelength is formulated. It has been found from the theory that waves propagating obliquely with respect to the electron beam are always unstable with appreciable growth rates; therefore, mode competition among the on-axis and off-axis modes is an important consideration in the design of the free-electron laser. Furthermore, electromagnetic waves with group velocities opposite to the direction of electron beam propagation are absolutely unstable if k/sub o/v/sub o/ > ω/sub pe/(1/γ/sup 3/2/ + 1/γ/sup 1/2/). Due to strong nonlinear saturation levels of the low-frequency absolute instability, the dynamics of the electron beam and the generation of the high-frequency electromagnetic radiation can be severely affected. Two-dimensional particle simulations show that the efficiency of generation of the on-axis high-frequency electromagnetic wave decreases significantly due to instability of the off-axis modes. In addition, complete disruption of the electron beam and laser oscillation due to the onset of the absolute instability have been observed in simulations.

29142 (UCID—19091) Review of nitrogen laser research, 1963-1973. Garcia, M. (Lawrence Livermore National Lab., CA (USA)). Jul 1981. Contract W-7405-ENG-48. 49p. NTIS, PC A03/MF A01. Order Number DE81027518.

This report is broken up into seven sections. The body begins with a description of exploratory, experimental nitrogen lasers; this description is done chronologically. Physical insights gained during the course of these experiments are also introduced chronologically so as to aid the reader in appreciating the improvements and disadvantages of successive approaches to the problem. A review is given of previously accepted models of this laser. The models presented are based on assumed inversion mechanisms which have recently been called into doubt. The fifth section of this report is a short one on the uses of the pulsed nitrogen laser; the sixth is the appendix where the details of devices discussed are summarized. To actually build a nitrogen laser, the best approach, short of solving the problem theoretically first, would be to peruse the appendix to get an idea of what would be involved and what to expect. The seventh section consists of the figures which give many of the numbers not discussed explicitly in the text, nor adequately displayed in the appendix.

29143 (UCRL—15350) High power copper vapor laser development. Anderson, C.E.; Anderson, R.S.; Bethke, G.W.; Homsey, R.J.; Karras, T.W. (Lawrence Livermore National Lab., CA (USA); General Electric Co., Philadelphia, PA (USA). Space Systems Div.). 18 Mar 1981. Contract W-7405-ENG-48. 127p. NTIS, PC A07/MF A01. Order Number DE81026601.

The development of a 50-watt copper vapor laser is described including the basic physics of operation, design principles, test results, and fabrication costs. Gain measurements at high power density in a copper vapor laser are described, and a detailed cost study for the production of the laser is presented. A study on the decontamination of insulating materials in copper vapor lasers is reported. (WHK)

29144 (UCRL—52000-81-8) Energy and technology review. (Lawrence Livermore National Lab., CA (USA)). Aug 1981. Contract W-7405-ENG-48. 37p. NTIS, PC A03/MF A01. Order Number DE81028501.

After a brief report on revised Hiroshima and Nagasaki dose estimates, the issue concentrates on three subjects: predicting integrated circuit performance; DYNA3D, computerized modeling of material deformation; and oil and gas resources, predicting the unpredictable. (GHT)

29145 Catalytic converters for closed-cycle operation of isotopic CO_2 tea lasers. Sorem, M.S.; Faulkner, G. (University of California, Los Alamos Scientific Laboratory, P.O. Box 1663, Los Alamos, New Mexico 87545). W-7405-ENG 36. *Review of Scientific Instruments ;* **52**: No. 8, 1193-1196(Aug 1981).

Long-term operation of high-power rare isotope CO_2 TEA lasers operating with high CO_2 concentrations (20%—25%) has been acheived using a variety of Pt and Pt-coated catalysts to drive the $CO+1/2O_2 \rightarrow CO_2$ recombination reaction. The problem of oxygen exchange between ^{18}O substituted CO_2 species (628, 828, 838, etc.) and the heated catalysts, or their supporting substrates, has been studied closely. It was found that Pt over an aluminum washcoat on a stainless steel substrate provided good catalytic activity with negligible oxygen exchange, if the Pt to Al_2O_3 mass ratio was near unity. Catalytic converter performance was analyzed for a typical laboratory CO_2 TEA laser (Lumonics 103) with a measured O_2 generation rate of ~0.15 liter Torr per liter of discharge volume per pulse. The laser output was correlated to the catalytic converter operating temperature, as well as the equilibrium O_2 concentration. Laser performance was typically degraded for O_2 concentrations in the discharge in excess of 0.1%.

29146 Wedge-and-strip anodes for centroid-finding position-sensitive photon and particle detectors. Martin, C.; Jelinsky, P.; Lampton, M.; Malina, R.F.; Anger, H.O. (Space Sciences Laboratory, University of California, Berkeley, California 94720). E-7405-ENG-48. *Review of Scientific Instruments ;* **52**: No. 7, 1067-1074(Jul 1981).

We discuss new anode geometries, employing position-dependent charge partitioning, which can be used with microchannel plates, planar proportional counters, and mesh dynode electron multipliers to obtain a two-dimensional position signal from each detected photon or particle. Only three or four anode electrodes and signal paths are required, yet images comprised of a number of detected events have little geometric distortion and the resolution is not limited by thermal noise inherent in resistive sheet anodes. We present an analysis of the geometrical image nonlinearity in the relationship between event centroid location and the charge partition ratios. Fabrication and testing of two wedge-and-strip anode systems are discussed. Images obtained with EUV radiation and microchannel plates that verify the predicted performance of this readout system are shown. We emphasize that the spatial resolution of the wedge-and-strip anode is in no way limited by the coarseness of the anode conductor pattern. The resolution is of the order of 0.4% of the image field size, and could be further improved by adopting low noise signal circuitry. Tradeoffs encountered in the design of practical x-ray, EUV, and charge particle image systems are discussed.

29147 Nonlinear saturations of parasitic instabilities in high-efficiency free-electron lasers. Lin, A.T. (Center for Plasma Physics and Fusion Engineering, University of California, Los Angeles, California 90024). DE-AM03-765F00010-PA-26, TASK III. *Physical Review Letters ;* **46**: No. 23, 1515-1518(8 Jun 1981).

A broad spectrum of unstable parasitic waves can arise from the interaction between the trapped electrons and the radiation generated by a free-electron laser. Imposing a dc electric field with appropriate strength at the onset of trapping can substantially narrow the unstable spectrum and allows considerable enhancement in the

radiation intensity. The nonlinear mechanisms which limit the enhancement process are observed to be due to nonlinear frequency shift and detrapping.

29148 **Picosecond ultrashort cavity dye laser: Giant pulse analogy and active etalon model.** Duncanson, J.A. Jr.; Struve, W.S. (Department of Chemistry and Ames Laboratory-USDOE, Iowa State University, Ames, Iowa 50011). *Journal of Applied Physics ;* **52**: No. 6, 3800-3820(Jun 1981).

The evolution of a tunable dye laser (TDL) pulse in an ultrashort cavity pumped by a monochromatic picosecond light pulse is described using the appropriate laser rate equations. The ultrashort duration of the excitation pulse typically reduces the treatment into one which is directly analogous to the giant pulse model of Wagner and Lengyel, applied previously to Q-switching dynamics in solid-state lasers. The spectral properties of the TDL pulse are calculated using an active etalon model, in which the bandwidth narrowing of the cavity axial modes is governed by the time-dependent gain derived from the giant pulse model. Theoretical conditions are obtained for achieving operating regimes which correspond to extraction of high pump→TDL conversion efficiencies, to the minimization of TDL pulse durations, or to shot-to-shot stabilization of output properties. The feasibility of extracting ~45% conversion of 531-nm SHG pulses from the mode-locked Nd^{3+} : glass oscillator using a 54-nm rhodamine 6G cavity is confirmed experimentally.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 28196, 28197, 28206, 28320

29149 **(LA-UR—81-1882) Computation of high Reynolds number internal/external flows.** Cline, M.C.; Wilmoth, R.G. (Los Alamos National Lab., NM (USA); National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). 1981. Contract W-7405-ENG-36. 12p. (CONF-810664—2). NTIS, PC A02/MF A01. Order Number DE81025343.

From 5. AIAA computational fluid dynamics conference; Palo Alto, CA, USA (22 Jun 1981).

A general, user oriented computer program, called VNAP2, has been developed to calculate high Reynolds number, internal/external flows. VNAP2 solves the two-dimensional, time-dependent Navier-Stokes equations. The turbulence is modeled with either a mixing-length, a one transport equation, or a two transport equation model. Interior grid points are computed using the explicit MacCormack scheme with special procedures to speed up the calculation in the fine grid. All boundary conditions are calculated using a reference plane characteristic scheme with the viscous terms treated as source terms. Several internal, external, and internal/external flow calculations are presented.

29150 **(LBL—12009) Generalized algebraic relation for predicting developing curved channel flow with a k-ϵ model of turbulence.** Humphrey, J.A.C.; Pourahmadi, F. (Lawrence Berkeley Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 17p. (CONF-810927—1). NTIS, PC A02/MF A01. Order Number DE81027572.

From 3. symposium on turbulent shear flow; Davis, CA, USA (9 Sep 1981).

Using algebraic approximations for the Reynolds stress equations a general expression has been derived for C/sub μ/ in ν/sub t/ = C/sub μ/ k^2/ϵ which accounts simultaneously for the effects of streamline curvature and pressure-strain in the flow, including wall-induced influences on the velocity fluctuations. The expression derived can be shown to encompass similar but more specific formulations proposed by Bradshaw, Rodi, and Leschziner and Rodi. The present formulation has been used in conjunction with k-ϵ model of turbulence to predict developing, two-dimensional, curved channel flows where both curvature and pressure-strain effects can be large. Minor modifications to include the influence of curvature on the length scale of the flow near the walls produces a significant improvement in the calculations. While, in general, predictions are in good agreement with experimental measurements of mildly and strongly curved flows, the model tends to overpredict the kinetic energy of turbulence in the inner-radius (convex) wall region. This is attributed to a breakdown of the assumption that u/sub i/u/sub j/k is a constant in the derivation of the general expression for C/sub μ/. Most of the experimental results suggest the presence of a weak cross-stream motion due to Taylor-Goertler vortices which cannot be resolved by the calculation scheme. Despite its limitations the present formulation provides a degree of generality not previously available in two-equation modeling of turbulent flows.

29151 **(PNL-SA—8768) Mean values and an inverse problem for porous media flow.** Arnold, E.M. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1980. Contract AC06-76RL01830. 21p. (CONF-801166—3). NTIS, PC A02/MF A01. Order Number DE81027210.

From SIAM fall meeting; Houston, TX, USA (6 Nov 1980).

Connections between integral mean values of a function and partial differential equations satisfied by that function are used to establish an equivalent integral-geometric form of an inverse problem for porous media flow. Some consequences of this equivalence and global existence results are presented.

29152 **PIC calculations of multiphase flow.** Cook, T.L.; Demuth, R.B.; Harlow, F.H. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Journal of Computational Physics ;* **41**: No. 1, 51-67(May 1981).

The Particle-in-Cell method for the numerical solution of problems in fluid dynamics has been extended to the study of shock and rarefaction flows in a multiphase mixture. To test the numerical procedure, we have examined the propagation of sound signals through a mixture in which the theoretical speed is appreciably less than that of either material separately, with results that validate the calculational technique.

29153 **High pressure homogeneous nucleation of bubbles within superheated binary liquid mixtures.** Avedisian, C.T.; Glassman, I. (Sibley School of Mechanical and Aerospace Engineering, Cornell University, Ithaca, N.Y. 14853 Assoc. Mem. ASME). EET-78-5-02-A920.A000. *Journal of Heat Transfer ;* **103**: No. 2, 272-280(May 1981).

The limits of superheat of some binary normal paraffin mixtures were measured at pressures up to 2128 kPa using the floating droplet method. The variation of nucleation temperature with liquid phase mole fraction was found to be nearly linear for these n-paraffin solutions over the whole pressure range in which the experiments were performed. Homogeneous nucleation theory was used to predict the limits of superheat of the solutions tested. The vapor pressures of the mixtures were estimated by using the Peng-Robinson equation of state to evaluate the liquid and vapor phase fugacities, and the mixture surface tensions were calculated using an empirical adaptation of the van der Waals expression for the surface tension of a pure liquid near the critical point. The predicted and measured limits of superheat were found to be in good agreement over the entire pressure range for all liquid phase compositions. The results of the present work could be useful for predicting liquid phase temperatures and compositions at which the microexplosive or disruptive burning of droplets of fuel blends which are mixtures of volatile and nonvolatile liquids will be initiated during droplet combustion at high ambient pressures.

29154 **Radiative heat transfer in a heat generating and turbulently convecting fluid layer.** Cheung, F.B.; Chan, S.H.; Chawla, T.C.; Cho, D.H. (Argonne National Lab., IL (USA)). *International Journal of Heat and Mass Transfer ;* **23**: No. 10, 1313-1324(Oct 1980).

The coupled problem of radiative transport and turbulent natural convection in a volumetrically heated, horizontal gray fluid medium, bounded from above by a rigid, isothermal wall and below by a rigid, adiabatic wall, is investigated analytically. An approximate method based upon the boundary layer approach is employed to obtain the dependence of heat transfer at the upper wall on the principal parameters of the problem, which, for moderate Prandtl number, are the Rayleigh number, Ra, the optical thickness, kL, and the conduction-radiation coupling parameter, N. Also obtained in this study is the behaviour of the thermal boundary layer at the upper wall. At large kL, the contribution of thermal radiation to heat transfer in the layer is found to be negligible for $N > 10$, moderate for N approximately 1, and overwhelming for $N < 0.1$.

However, at small kL, thermal radiation is found to be important only for $N < 0.01$. While a higher level of turbulence results in a thinner boundary layer, a larger effect of radiation is found to result in a thicker one. Thus, in the presence of strong thermal radiation, a much larger value of Ra is required for the boundary layer approach to remain valid. Under severe radiation conditions, no boundary layer flow regime is found to exist even at very high Rayleigh numbers. Accordingly, the ranges of applicability of the present results are determined and the approximate method justified. In particular, the validity of the present analysis is tested in three limiting cases, i.e., those of $kL \rightarrow$ infinity, $N \rightarrow$ infinity, and $Ra \rightarrow$ infinity, and is further confirmed by comparison with the numerical solution.

4205 Materials Testing

REFER ALSO TO CITATION(S) 28884

29155 **(UCRL—86099) On-line failure detection of vibrating structures.** Azevedo, S.G.; Candy, J.V.; Lager, D.L. (Lawrence Livermore National Lab., CA (USA)). 27 May 1981. Contract W-7405-ENG-48. 26p. (CONF-810918—1). NTIS, PC A03/MF A01.

From ASME conference on mechanical vibration and noise; Hartford, CT, USA (20 Sep 1981).

Nondestructive evaluation of vibrating structures for failure detection is an area of interest at the Lawrence Livermore National Laboratory. Recent advances in signal processing and analysis of vibrating structures has been applied to this problem with promising results. The techniques used are recursive on-line algorithms which include stochastic models for noise sources. An experiment was designed to investigate the feasibility of signal processing procedures for failure detection. A given structure was excited and its shock response measured using an accelerometer. The response data was digitized and processed. This failure detection problem was approached from the stochastic estimation theory viewpoint. First, we characterize the structural model from experimental data, then construct a failure detector based on this model. A nonlinear identification algorithm (using an extended Kalman filter) is utilized for estimating modal parameters from vibration data. Using this model of the structure, a signal processing estimator is designed to increase the output signal-to-noise ratio. The estimator is followed by a decision device to detect structural failures or anomalies. The results of this feasibility study indicate reasonable performance of these techniques for model characterization and failure detection. Exampies and graphical illustrations are presented.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 28345

29156 **(SAND—81-1087C) Modeling and elimination of latch-up in bulk CMOS integrated circuits.** Ochoa, A. Jr.; Dressendorfer, P.V. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 3p. (CONF-810908—1). NTIS, PC A02/MF A01. Order Number DE81017413.

From Symposium on VLSI technology; Maui, HI, USA (9 Sep 1981).

Bulk CMOS ICs will continue to be a competitive technology as we enter the VLSI era of microelectronics, but may suffer from the problem of four-layer SCR paths which can become activated causing latch-up of the part. In this paper we improve the fundamental understanding of this phenomena by analyzing the various modes of latch-up, the effects of contact and spreading resistance, and other distributed effects. We then employ this analysis to discuss design and process solutions for the prevention of latch-up in VLSI structures.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 28131, 28133, 28136, 28137, 28147, 28151, 28587, 28618, 28622

29157 **(DOE/ET/12307—T2) Design, construction, operation, and evaluation of a prototype culm-combustion boiler/heater unit. Quarterly technical progress report, October 1-December 31, 1980.** (Curtiss-Wright Corp., Wood-Ridge, NJ (USA). Power Systems Div.). Feb 1981. Contract AC21-78ET12307. 42p. (FE—2269.39A; CW-WR—78-O36.39A). NTIS, PC A03/MF A01.

This report provides a summary of the work performed on the Prototype Culm Combustion Boiler/Heater Unit, Phase I - Engineering Design and Analysis and Phase II - Prototype Plant Construction during the period October 1, 1980 through December 31, 1980. The objectives of the program as well as the technical progress and problem areas encountered during the reporting period are presented. The final detail design effort was completed and the final design report submitted. Progress on procurement activity authorized by full Phase II release on March 20, 1980, is discussed. Following approval by DOE, a purchase order was placed with the Norflor Construction Corporation for the prototype plant construction which began in November. Construction of the access roadway installation of the electric power, sewer and water lines was completed during this reporting period. Boiler construction continued.

29158 **(DOE/PC/40272—T1) Mechanisms of fouling, slagging and corrosion by pulverized coal combustion. Quarterly technical progress report No. 1, March 11-June 30, 1981.** Gulden, M.E.; Hsu, L.L.; Stetson, A.R. (Solar Turbines International, San Diego, CA (USA)). Jul 1981. Contract AC22-81PC40272. 52p. NTIS, PC A04/MF A01. Order Number DE81027888.

Progress is reported on a program in which the objective is to conduct a detailed and comprehensive study of the mechanisms of fouling, slagging and corrosion in pulverized coal combustors by employing well controlled model systems which simulate the coal combustion environment. Emphasis during this period has been on design and construction of the combustion test rig. All design phases are complete. Construction of the diffuser and test sections is also complete.

4220 Underground Engineering

29159 **(LA—8907-MS) National mine subsidence engineering research program.** Smith, P. (Los Alamos National Lab., NM (USA)). Jul 1981. Contract W-7405-ENG-36. 49p. NTIS, PC A03/MF A01. Order Number DE81028592.

A logical approach is suggested to choosing and sequencing research activities to attain a suitable set of techniques for predicting the damaging consequences of mine subsidence. The detail required for damage predictions varies from customers who conduct regional impact assessments to subsidence hazard engineers who are concerned with a particular structure that is to be undermined. High priority research needs are a National Mine Subsidence Information Management Center, empirical surface and subsurface subsidence damage correlations for US practice, a comprehensive study of influence function subsidence prediction techniques, finite element computer code refinements for full-extraction subsidence prediction, an engineering geology approach to assessing the timing of room-and-pillar subsidence, and well-designed field observations in support of all research needs. Current field measurements must be redirected to improve interagency coordination and to emphasize observation of subsurface responses during subsidence.

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 28087, 28621, 28622, 28623, 28624, 28625, 28626, 28627, 28628, 28629, 28630, 28631, 28632, 28633, 28634, 28635

29160 Kinetic studies on the reactions involved in the hot gas desulfurization using a regenerable iron oxide sorbent. II. Reactions of iron sulfide with oxygen and sulfur dioxide. Tseng, S.C.; Tamhankar, S.S.; Wen, C.Y. (West Virginia Univ., Morgantown, WV). *Chemical Engineering Science ;* **36**: No. 8, 1287-1294(1981).

In the hot gas desulfurization process using iron oxide sorbent, the regeneration of the sulfided iron oxide sorbent consists of two reactions: the oxidation of iron sulfide with the air, and its reaction with the sulfur dioxide formed during the air oxidation. This part describes the kinetic studies on the reactions of iron sulfide (formed by the reactions of Fe_2O_3 with H_2-CO mixture and subsequently with H_2S) with oxygen and sulfur dioxide. The experimental and analysis procedures used are similar to those outlined in Part I of this paper. The activation energies for the oxygen and the sulfur dioxide reactions are found to be 15.63 and 17.5 kcal/mol, respectively. Notably, the product oxides formed in the two cases are different. With air, the reaction is fast and the final product is Fe_2O_3, whereas with SO_2, the major product is Fe_3O_4, which slowly oxidizes to Fe_2O_3 in a secondary step. Also, in the latter reaction elemental sulfur is formed.

4250 Power Cycles

REFER ALSO TO CITATION(S) 28347, 28348, 28349

29161 (DOE/SF/01123—T30) Brayton isotope power system. Phase I. Ground demonstration system, configuration control document (CCD). (AiResearch Mfg. Co., Phoenix, AZ (USA)). 14 Dec 1976. Contract AS03-76SF01123. 339p. NTIS, PC A15/MF A01.

This document defines the configuration of the Brayton Isotope Power System - Ground Demonstration System (BIPS-GDS). The GDS is similar to a conceptual flight system (FS) design. It is intended that the GDS simulate the FS as closely as possible. Performance testing of the GDS over the full power range will be followed by a 1000-h endurance test. This document includes reference material, a related documents listing, and pertinent system and components design data. Also included is a preliminary BIPS-FS design description and appropriate background information that may be useful to potential users. All drawings referenced in the text are included in an appendix. (LCL)

29162 (DOE/SF/01123—T31) Product quality assurance program plan for Phase I with advanced program planning for Phase II Brayton Isotope Power Systems (BIPS). (AiResearch Mfg. Co., Phoenix, AZ (USA)). 7 Jul 1977. Contract AC03-76SF01123. 149p. NTIS, PC A07/MF A01.

This Quality Assurance Program Plan sets forth general requirements for planning, managing, conducting, and evaluating the Quality Assurance Program for Brayton Isotope Power Systems, Phase I and II. These requirements are based on a proven quality system that is supplemented with the additional controls specified in this program plan to assure that quality, safety and reliability will be achieved in an economical manner. The objective of the program covered by this publication is to assure that systems, components, piece parts, materials and technical data are established and maintained in compliance with the general intent of the contractual requirements. This Quality Assurance Program has been established and implemented to prevent, detect, and correct deficiencies and provides reliable technical data.

29163 (DOE/SF/90478—T3) Technology assessment heat-engine components R and D for components and heat engines branch conrt. (TRW Systems Group, McLean, VA (USA)). 31 Mar 1977. Contract AT03-76SF90478. 11p. NTIS, PC A02/MF A01.

The purpose of this study is to plan for a components and heat engine technology base for advanced conversion systems emphasizing fuel savings, fuel substitution and cost-effectiveness. The technology base will serve for improving heat engine conversion efficiencies and widening their fuel capabilities. It will help to shorten the lead time necessary for demonstrating and commercializing new conversion systems by anticipating and developing critical component technologies. Heat engines for stationary and vehicular use are included. A listing of systems of interest and their components was prepared. These energy conversion systems include open- and closed-cycle gas turbines; Stirling engines; topping and bottoming cycles; diesel and spark-ignition engines; pumps; fuel cells; heat pumps; and electric motors. For each component the relevant R and D work is stated.

43 PARTICLE ACCELERATORS

4301 Design, Development, And Operation

29164 (LA—8839) Variable-energy drift-tube linacs. Swenson, D.A.; Boyd, T.J. Jr.; Potter, J.M.; Stovall, J.E. (Los Alamos National Lab., NM (USA)). Jul 1981. Contract W-7405-ENG-36. 7p. NTIS, PC A02/MF A01. Order Number DE81028598.

Practical applications of ion linacs are more viable now than ever before because of the recent development of the radio-frequency quadrupole accelerating structure, as well as other technological advances developed under the Pion Generator for Medical Irradiations program. A practical technique for varying the energy of drift-tube linacs and thus further broadening the possibilities for linac applications is described. This technique involves using the post couplers (normally used to flatten and stabilize the electric field) to create a step in the fields, thus terminating the acceleration process. Using this technique and a 70-MeV accelerator design, the examples show that energy is variable continuously down to 20 MeV, and a small energy spread is maintained.

29165 (UCRL—85557) Beam tests on the 4-kA, 1.5-MeV injector for FXR. Kulke, B.; Kihara, R.; Ravenscroft, D.; Scarpetti, R.; Vogtlin, G. (Lawrence Livermore National Lab., CA (USA)). 1981. Contract W-7405-ENG-48. 9p. (CONF-810620—14). NTIS, PC A02/MF A01. Order Number DE81027437.

From 4. international topical conference on high-power electron and ion-beam research and technology; Palaiseau, France (29 Jun 1981).

The new flash x-ray machine (FXR) at Lawrence Livermore National Laboratory is scheduled for completion in late 1981. This is a 54 module, linear induction accelertor, designed to deliver 500 Roentgen at 1 m as bremsstrahlung from a 20 MeV, 4 kA, 60 ns pulsed electron beam. The 9 cm diameter, cold-cathode electron source generates a 15 kA emitted beam at 1.5 MeV, and collimation is being used to reduce the transmitted current to 3.5 kA, with an emittance of 70 mr-cm. The collimated beam diameter is 4 cm. Six ferrite-loaded cavities are used in tandem to energize the injector. The high voltage performance of the injector cavities and other pulsed-power conditioning elements was tested earlier in a series of 10^5 shots at 400 kV per cavity. An overview of the injector design and of the beam test results is given.

29166 New high-brightness multiple beam linear accelerator. Gammel, G.M.; Maschke, A.W.; Mobley, R.M. (Brookhaven National Laboratory, Upton, New York 11973). *Review of Scientific Instruments ;* **52**: No. 7, 971-974(Jul 1981).

A new concept for the linear acceleration of high brightness particle beams, and a description of one working model, are presented. The idea involves the simultaneous acceleration of a large number of low current beamlets in individual, small bore, electrostatic quadrupole focussing channels. Large total current can be reached.

4302 Beam Dynamics, Field Calculations, And Ion Optics

29167 (LBL—12793) PET computer programs for use with the 88-inch cyclotron. Gough, R.A.; Chlosta, L. (Lawrence Berkeley Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 152p. NTIS, PC A08/MF A01. Order Number DE81027624.

This report describes in detail several offline programs written for the PET computer which provide an efficient data management system to assist with the operation of the 88-Inch Cyclotron. This function includes the capability to predict settings for all cyclotron and beam line parameters for all beams within the present operating domain of the facility. The establishment of a data base for operational records is also described from which various aspects of the operating history can be projected.

29168 **(LBL—12878) Resistive wall instability in a uniform beam: simulation vs analytical results.** Sternlieb, A. (Lawrence Berkeley Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 27p. NTIS, PC A03/MF A01. Order Number DE81026269.

The time-dependent behavior of the resistive wall instability in a uniform charged beam is investigated by means of computer simulation. Results are compared with linear analytical results for a range of cases in which two parameters are varied: the resistive wall term and the initial thermal spread of the beam. In general, good agreement is found between simulation and theoretical results. The main conclusion is that the growth rate of any mode increases with the resistive term and decreases as a function of the thermal spread. There is always a maximum marginally unstable wavenumber k for any nonzero thermal spread. The linear growth rate is roughly the same for the thermal spread and for the electric field amplitude. An overshoot phenomenon is present, in the sense that the thermal spread continues to grow after the electric field has reached saturation.

29169 **(SAND—81-1605) Evaluation of two proposed improvements to the gradient B drift geometry.** Backstrom, R.C. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1981. Contract AC04-76DP00789. 35p. NTIS, PC A03/MF A01. Order Number DE81028668.

Recent work relating to various gradient transport schemes for electron pulse compression are discussed. First, the magnetic fields in the schemes are calculated. Infinite wire fields are found to be correct regardless of the entrance foil cone angle. The fields outside the transport volumes are zero. Next, the electron drift rates and injection criteria are extended and verified numerically. The injection criteria are valid for any entrance foil cone half angle between 0 and $\pi/2$ radians. Finally, two improvements to the basic transport scheme in the references are evaluated. The conical entrance foil idea seems to be the best way of increasing warm beam electron injection efficiencies. This idea would not work for a cold beam because the cold beam electrons' angles, α, would be less than the critical angle needed for injection. The cold beam injection efficiency, however, can be improved by the use of double entrance foils with a reversed current. The double entrance foil idea with a forward current appears to be unsatisfactory because beam radii increase greatly. The main disadvantage of these ideas is increased complexity. One should note, however, the conclusions in this report are all based on assumed electron beam distributions. Different results may be obtained when the actual distributions emitted from the candidate electron diodes become known.

29170 **Longitudinal stability of intense nonrelativistic particle bunches in resistive structures.** Channell, P.J.; Sessler, A.M.; Wurtele, J.S. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). W-7405-ENG-48. *Applied Physics Letters ;* **39**: No. 4, 359-361(15 Aug 1981).

The longitudinal stability of intense particle bunches is investigated theoretically in the limit of small wall resistivity compared to total reactance. It is shown that both in the absence of resistivity and to lowest order in the resistance that an intense bunch is stable against longitudinal collective modes. An expression is derived for the lowest order instability rate. Application of these results are made to drivers for heavy ion inertial fusion.

29171 **Laser cooling of heavy-ion beams.** Channell, P.J. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). W-7405-ENG. 36. *Journal of Applied Physics ;* **52**: No. 6, 3791-3793(Jun 1981).

We present a new technique for cooling heavy-ion beams. The discrete absorption spectrum of the ions and the transverse Doppler shift distinguish the transverse direction of velocity and cool the ions by photon absorption. We evaluate the total energy and time requirements for a particular example relevant to heavy-ion fusion.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 29165, 29178, 29179, 29448, 29757

29172 **(ANL—81-22) Calculations of the heat deposition and the expected rate of temperature rise in moderator, reflector, and decoupler materials for IPNS-I.** Kimura, M.; Carpenter, J.M.; Mildner, D.F.R. (Argonne National Lab., IL (USA); Missouri Univ., Columbia (USA). Research Reactor Facility). Apr 1981. Contract W-31-109-ENG-38. 34p. NTIS, PC A03/MF A01. Order Number DE81027135.

The neutron and gamma fluxes at the center of a moderator and their average energies have been estimated for the IPNS-I configuration (5×10^{12} ppp, 500 MeV, 30 Hz with ^{238}U target). The gamma decay factor, the ratio of γ intensity when proton beam is on to that of just-after-beam-off, has been calculated. The heat deposition rate in the moderator and the temperature rise without heat flow are estimated to be 41.1 mW/cc and 1.13 K/min respectively, for a polyethylene moderator. Estimates for liquid hydrogen moderators give 17.3 mW/cc and 2.1 K/min respectively. Estimates are also made for the heat deposition rates in the boron and cadmium decouplers. Some consideration was given to the thermal characteristics (cooling constant, etc.) of various materials in conjunction with the ZING-P' measurements. The possible temperature difference between moderator and a thermocouple was estimated and found to be very small. Measurements on the ZING-P' beams and the comparison with these estimates are given in a separate report.

29173 **(BNL—29612) Brookhaven National Laboratory Tandem accelerator upgrading program.** Thieberger, P.; Manni, M.A.; Lindgren, R.; McKeown, M.; Carlson, C.; Wegner, H.E. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 4p. (CONF-810468—9). NTIS, PC A02/MF A01. Order Number DE81025093.

From 3. international conference on electrostatic accelerator technology; Oak Ridge, TN, USA (13 Apr 1981).

The three-stage Tandem Van de Graaff accelerator facility at Brookhaven National Laboratory has undergone various upgrading programs since the early 1970's. The original 10 MV waranteed MP Van de Graaff accelerator of 1970 now operates in excess of 14 MV because of many improvements over the years: the purpose of this paper is to report on the most recent improvements which have been completed and also on those that are presently under construction and being implemented.

29174 **(SAND—81-1713C) Dielectric materials for structural applications and high-voltage insulation in deionized water for particle-beam accelerators.** Furaus, J.P. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 4p. (CONF-810659—27). NTIS, PC A02/MF A01. Order Number DE81027203.

From 3. IEEE international pulsed power conference; Albuquerque, NM, USA (1 Jun 1981).

The pulsed energy programs at Sandia National Laboratories (SNLA) have often required dielectric materials that provide a dual role of high voltage insulation as well as critical structural support. One typical application is the dielectric tension rods for the trigatron gas switch used on the PBFA-I Accelerator. This paper describes the performance of dielectric materials used in the past and recent evaluations of alternative materials that have resulted in significant cost and performance improvements.

29175 **(SLAC-PUB—2715) Oxide effects on photoemission from high current GaAs photocathodes.** Garwin, E.L.; Kirby, R.E.; Sinclair, C.K.; Roder, A. (Stanford Linear Accelerator Center, CA (USA)). Mar 1981. Contract AC03-76SF00515. 18p. (CONF-810495—2). NTIS, PC A02/MF A01. Order Number DE81025129.

From Interdisciplinary surface science conference; Liverpool, UK (6 Apr 1981).

During four years of on line operation of the SLAC polarized electron gun (PEGGY) and polarized LEED (PLEED) system, we have observed and characterized the failure modes of the GaAs (100) photocathodes (PC's) used in these systems. Several modes are observed. Gradual decreases in electron polarization and intensity are attributed to the physisorption of CO_2 on the PC's during running at LN_2 temperatures. Such PC's can be rejuvenated by warming to 90K, i.e., above the CO_2 desorption temperature. These PC's recover 90% of their original intensity. A second well-characterized failure mode results from overheating the PC during in-situ heat cleaning prior to activation. In this mode, As is preferentially evaporated from the GaAs, leaving a Ga_2O_3 layer on the surface. This effect has been studied by AES sputter profiling which indicates that the substantial thickness of the oxide layer blocks photoemission. These PC's may only be recovered by chemically removing the oxide layer. A third mode which is not as well characterized appears for thin Ga oxide layers. Properties of these PC's include reduced emission and the presence of a cutoff bias level. Such PC's are also not recoverable in-situ.

29176 **(UCRL—85429) Development of manufacturing methods for 50-cm diameter neutron source targets for RTNS-II.** Logan, C.M.; Dini, J.W.; Ludemann, W.D.; Schumacher, B.J.; Dalder, E.N.C.; Kelley, W.K.; Harter, G.A. (Lawrence Livermore National Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 6p. (CONF-810831—3). NTIS, PC A02/MF A01. Order Number DE81026005.

From Fusion reactor materials meeting; Seattle, WA, USA (9 Aug 1981).

RTNS-II is an accelerator driven neutron source. It was attempted to produce a larger version of the current accelerator target but experienced problems in diffusion bonding and thermal stability of the copper alloy used for target fabrication. The causes of these problems were identified, and a new technique (electroforming) was demonstrated for fabricating targets.

29177 **Geometrically focused neutral beam accelerators.** Molvik, A.W.; Munger, R.H.; Duffy, T.J.; Correll, D.L. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). W-7405-ENG-48. *Review of Scientific Instruments ;* **52**: No. 7, 965-970(Jul 1981).

A more reliable 40 kV, 65 A power supply drain at 0.4 A/cm², neutral-beam accelerator was developed for the Tandem Mirror Experiment (TMX). Multiple slotted aperture grids of 60% transparency are fabricated from refractory metal wires mounted to form a spherical surface. This geometrically focuses the beam by aiming individual beamlets at the center of curvature of the spherical grid (r = 3.2 m). We attain greater reliability and faster conditioning with geometrical focusing than with the previous technique of electrostatically steering beamlets to a common point. Electrostatic steering, accomplished by offsetting grid wires, is satisfactory if the offset of a beamlet is much less than the distance from the beamlet to the grids. It was found that Pierce Angle entrance grids performed better if sharper edged. A redesigned accelerator grid support structure reduced the number of ceramic-to-metal vacuum joints, and eliminated O rings between precisely aligned parts. The suppressor grid feedthrough is required to withstand a maximum voltage of 15 kV occurring during breakdown, greatly exceeding the operating voltage of 1.5 kV. Convenient fabrication and assembly techniques have been developed. Assembly of accelerators and plasma sources in a clean room appears to reduce the conditioning time. Following the successful testing of the prototype, eight 40 kV accelerators were built for TMX. Furthermore, ten 20 kV versions were built that are modifiable to 40 kV by exchanging the entrance grid.

4304 Storage Rings

REFER ALSO TO CITATION(S) 29396, 29403, 29404, 29405, 29406, 29447, 29556

29178 (BNL—28832, pp 54-70) **National synchrotron light source basic design and project status.** van Steenbergen, A. (Brookhaven National Lab., Upton, NY). Jan 1981. NTIS, PC A10/MF A01.

From Workshop on atomic physics at the national synchrotron light source; Upton, NY, USA (15 Sep 1980).

A summary description and the basic design parameters of the National Synchrotron Light Source, a facility for the generation of intense synchrotron radiation in the vuv and x-ray range is presented, the parameters of the sources are given, the presently planned facility beam lines are tabulated and the status of the project is indicated.

29179 **(LA-UR—81-1851) Status of the Los Alamos proton storage ring.** Cooper, R.K.; Spalek, G. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 4p. (CONF-8106120—3). NTIS, PC A02/MF A01. Order Number DE81025350.

From 5. meeting of the international collaboration on advanced neutron sources; Julich, F.R. Germany (22 Jun 1981).

The Proton Storage Ring for the Weapons Neutron Research Facility of the Los Alamos National Laboratory is reviewed as a construction project. The current status of construction and design is outlined.

29180 **Nuclear physics with synchrotron radiation.** Chrien, R. (Brookhaven National Lab., Upton, NY (USA)); Hofmann, A.; Molinari, A. (European Organization for Nuclear Research, Geneva (Switzerland)). Amsterdam, Netherlands; North-Holland Publishing Co. (1980). 130p.

The characteristics of synchrotron radiation originating from a very high energy electron-positron storage ring are presented. Emphasis is put on the high energy part of the spectrum which is relevant to nuclear physics research. The physics potential of such intense photon beams is reviewed with discussions of photonuclear reactions and of neutron-induced reactions with photoproduced neutrons.

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 28331, 28694, 29448, 29449

29181 (BNL—28832, pp 117-128) **Photon detection in the vuv.** Samson, J.A.R. (Univ. of Nebraska, Lincoln). Jan 1981. NTIS, PC A10/MF A01.

From Workshop on atomic physics at the national synchrotron light source; Upton, NY, USA (15 Sep 1980).

The fundamental processes involved in the detection of vacuum ultraviolet (vuv) radiation are the photoelectric effect and photoionization of a gas. Detectors used are summarized and discussed.

29182 (BNL—28832, pp 129-135) **Electron spectrometers.** Woodruff, P.R. (Univ. of Wisconsin, Stoughton). Jan 1981. NTIS, PC A10/MF A01.

From Workshop on atomic physics at the national synchrotron light source; Upton, NY, USA (15 Sep 1980).

Measurements made using electron spectrometers can lead to the determination of all the parameters that fully characterize the photoionization process. The measurements fall into three categories: the angular independent flux of the photoelectrons which leads to the partial cross section, the angular distribution of the photoelectrons, and the spin of the photoelectrons. The majority of this paper is concerned with electron energy analyzers which can be used to measure both the partial cross section and the angular distribution.

29183 **(BNL—29675) Use of microprocessors in a neutrino experiment.** Connolly, P.L.; Cutts, D. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 6p. (CONF-810539—8). NTIS, PC A02/MF A01. Order Number DE81026057.

From Conference on the application of microprocessors to high energy physics experiments; Geneva, Switzerland (4 May 1981).

Microprocessors are a fundamental part of the neutrino detector for Experiment 734, a study of νe elastic scattering at Brook-

haven National Laboratory. Four DEC LSI-11s are interfaced each to 1/4 of the detector apparatus via programmable scan controllers and to the central DEC 11-34 via separate DMA links. These microprocessors act in parallel to collect and reformat data from ν events; further, they can act independently, orchestrating an elaborate variety of calibrations asynchronously in different regions of the apparatus. Our micros have proved to be very valuable for a number of reasons. It is much easier to manage a large detector in separate pieces. Each LSI-11 can run in stand-alone mode, allowing independent installation or checkout of different parts of the detector. When operational the apparatus must be continuously calibrated; with a very large number of separate detector elements, distributed intelligence is most useful.

29184 (BNL—51380, pp 171-188) **ν-oscillation experiment at BNL.** Bozoki, G. (Brookhaven National Lab., Upton, NY); Fainberg, T.; Gordon, H. 1981. NTIS, PC A15/MF A01.

From Neutrino oscillation workshop; Upton, NY, USA (30 Jan 1981).

Construction of a 100 ton fiducial volume water Cherenkov test detector segmented with wave shifter bars is proposed. When completely instrumented, it will form one of two detectors needed for the possible experiments described. It will be located ~ 200 m from the ν target. Transitions between neutrino flavors are not ruled out in the current theories. Neither is the possibility that all or some neutrinos may carry some masses. So there are distinct possibilities that neutrinos may oscillate into each other. There is some experimental evidence for such oscillation but none is conclusive. The opportunities that exist at the AGS, BNL to explore this topical question are discussed. In the discussion, no attempt is made to optimize the experimental design or to take practical considerations into account. Detectors 1, 2, and 3 are defined to be ~ 100 tons, ~ 100 tons, ~ 1000 tons at ~ 100 m, ~ 200 m, ~ 1000 m from the ν target, respectively.

29185 **(CONF-810668—1) Scientific innovation and resonance ionization spectroscopy.** Richmond, C.R. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 16p. NTIS, PC A02/MF A01. Order Number DE81023193.

From Symposium on resonance ionization spectroscopy and its applications; Gatlinburg, TN, USA (2 Jun 1981).

An account is presented of the development and appliations of resonance ionization spectroscopy and one atom detection.

29186 **(DOE/ER/10667—T1) Studies of the applicability of optoelectronic devices for instrumentation in high-energy physics. Progress report, June 1, 1980-May 31, 1981.** Cleland, W.E.; Thompson, J. (Pittsburgh Univ., PA (USA). Dept. of Physics and Astronomy). Jan 1981. Contract AC02-80ER10667. 51p. NTIS, PC A04/MF A01.

Instrumentation research to study the applicability of optoelectronic devices to problems in High Energy Physics has been under way since June 1, 1981. The thrust of the program has been to examine possibilities for using incoherent optical processing techniques in order to carry out real-time pattern recognition on the time scale required for the triggering of High Energy Physics experiments. The properties of the various types of optical processors have been understood and an incoherent correlator which could recognize several patterns in an array of independently driven light sources, such as LEDs or injection lasers, is probably feasible. The necessary equipment and computer programs were developed to permit the production of computer-generated holograms and kinoforms, elements which would become the filters in an incoherent optical correlator. The problems of making reliable kinoforms will be studied to build a simple correlator and test its properties.

29187 **(DOE/EV/04957—1) In vivo detection, localization, and measurement of radionuclides in man: a detection system for the localization and measurement of small amounts of photon emitters. Progress report, September 1, 1978-May 15, 1979.** Laurer, G.R. (New York Univ., NY (USA). Medical Center). 15 Jun 1979. Contract AS02-78EV04957. 97p. (COO—4957-1). NTIS, PC A05/MF A01.

The design, construction, and testing of a photon detection system which will yield, simultaneously, information proportional to both the magnitude and location of sources of radioactivity were undertaken. The operating principle of the detector system, active collimation, allows spatial resolution by utilizing the crystal elements themselves as the collimating device; hence a greater counting efficiency is attainable than with other currently available systems. The differences in characteristics of various crystals are utilized as the means of separating events occurring in each of five crystals. Mathematical processing of the counts from the individual crystals is then employed in conjunction with their geometric relationship to develop both positional data and to quantify the amount of radioactivity. By utilizing crystal detector elements in an active collimation configuration and incorporating them in an array which permits these crystals to be alternately advanced and retracted in a programmed, ordered manner, a high degree of spatial resolution is believed achievable without unduly compromising system sensitivity. Experiments were planned with a detector of optimized design to provide data on the ultimate performance that can be achieved with an N-element detector array. The experiments include development of the optimal crystal configuration, studies to ascertain the most efficient crystal shape, and the evolving of data processing techniques to translate detector response into precise source position information.

29188 **(EGG-M—01181) Efficiency calibration of a Ge detector for 30-2800 keV γ rays.** Helmer, R.G. (Idaho National Engineering Lab., Idaho Falls (USA)). 1981. Contract AC07-76ID01570. 22p. (CONF-810647—9). NTIS, PC A02/MF A01. Order Number DE81028277.

From Conference on X- and gamma-ray sources and applications; Ann Arbor, MI, USA (10 Jun 1981).

A Ge detector has been calibrated to allow the measurement of γ-ray emission rates from 30 to 2800 keV for point sources. The estimated uncertainty in the resulting efficiency varies from 2% below 85 keV to 0.5% from 400 to 1400 keV. These measurements involved about 22 sources, 20 isotopes and 61 γ rays with energies from 14 to 2754 keV. The calibration sources, obtained primarily from two metrology laboratories and our own laboratory, included both primary standards and secondary standards containing several γ rays. The results from sources from different laboratories are compared. The magnitudes of various corrections and the various components of the uncertainty are noted. The half-lives and the γ-emission probabilities for the calibration sources have been evaluated.

29189 **(LBL—12678) Bragg Curve Spectroscopy.** Gruhn, C.R. (Lawrence Berkeley Lab., CA (USA)). May 1981. Contract W-7405-ENG-48. 27p. (CONF-810351—3). NTIS, PC A03/MF A01. Order Number DE81025827.

From INS meeting on nuclear radiation detectors; Tokyo, Japan (23 Mar 1981).

An alternative utilization is presented for the gaseous ionization chamber in the detection of energetic heavy ions, which is called Bragg Curve Spectroscopy (BCS). Conceptually, BCS involves using the maximum data available from the Bragg curve of the stopping heavy ion (HI) for purposes of identifying the particle and measuring its energy. A detector has been designed that measures the Bragg curve with high precision. From the Bragg curve the range from the length of the track, the total energy from the integral of the specific ionization over the track, the dE/dx from the specific ionization at the beginning of the track, and the Bragg peak from the maximum of the specific ionization of the HI are determined. This last signal measures the atomic number, Z, of the HI unambiguously.

29190 **(SAND—81-0451C) IC-compatible ionizing-radiation detector.** Dawes, W.R. Jr.; Schwank, J.R. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 34p. (CONF-810707—5). NTIS, PC A03/MF A01. Order Number DE81027105.

From IEEE conference on nuclear science and space radiation; Seattle, WA, USA (21 Jul 1981).

A new type of MOS ionization dosimetry device, which offers several major advantages over present detectors, is described. This device is fabricated using radiation-hardened CMOS processing technology, allowing integration of the ionization detector with radiation-hardened integrated circuits. The detector can be used as part of a circuit element which either switches state at a precisely

controlled radiation level or provides an output voltage (or current) proportional to the total radiation dose. The radiation level at which the detector switches can be controlled either by a single precisely controlled process change, which also controls the rate of change of the output voltage versus irradiation level, or by an external bias. Dosimetry devices have been fabricated and tested under ionization radiation at levels from 5×10^3 to 5×10^5 rads (Si).

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

REFER ALSO TO CITATION(S) 29712

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 28144, 28195, 28196, 28197, 28674, 28697, 28952, 29115, 29139, 29203, 29212, 29289, 29344, 29345, 29377

29191 (BNL—51318, pp 43-54) **Major parameters affecting temperature inside inhalation chambers.** Bernstein, D.M.; Drew, R.T. (Brookhaven National Lab., Upton, NY). 1978. NTIS, PC A06/MF A01.

From Inhalation chamber technology conference; Upton, NY, USA (16 Oct 1978).

Control of the internal temperature of inhalation chambers is crucial to the proper performance of animal inhalation studies. During exposure, chambers should be kept at 22° to 25°C which is the recommended temperature for housing of rats. This report quantifies the different modes of heat transfer in a chamber and determines the most efficient methods of removing from the chamber the heat generated by the animals. These studies showed that stainless steel chamber walls were very effective at removing heat from an (380 l) inhalation chamber. Cooling the incoming air was not as effective in cooling the stainless steel chamber, because most of the heat transfer from the animals in the chamber was by thermal radiation and the cooled intake air was rapidly heated through the chamber wall by the surrounding room environment. This study has also shown that by measuring an effective heat transfer coefficient for a chamber one can determine for specific flow rates the maximum room temperature permissible to maintain a reasonable chamber temperature with varying animal loadings.

29192 (DOE/ER/02119—24) **Experiments in high voltage electron microscopy. Progress report for research, October 31, 1980-June 1981.** Mitchell, T.E.; Hobbs, L.W.; Mukai, T.; Liu, H.; Pascucci, M.; Youngman, R.A. (Case Western Reserve Univ., Cleveland, OH (USA). Div. of Metallurgy and Materials Science). Jun 1981. Contract AS02-76ER02119. 25p. (COO—2119-24). NTIS, PC A02/MF A01. Order Number DE81025574.

The research described in this report is concerned with fundamental studies of radiation damage in metals and ceramics, in particular its direct observation using high voltage electron microscopy (HVEM). HVEM is well established as an important research tool, not only for radiation damage studies, but also for its increased penetration of specimens, decreased aberrations and its facility for in situ experiments such as environmental interactions and deformation studies. The present authors have discussed the past, present and future of HVEM radiation damage studies, pointing out the advantages, problems, and interesting challenges for the future.

29193 (DOE/ER/10393—T1) **Improved instrument for the measurement of thermal conductivity of non-electrolyte liquids. Progress report No. 2, January 15, 1980-June 1, 1981.** Sloan, E.D.; Graboski, M.S. (Colorado School of Mines, Golden (USA)). 1981. Contract AS02-79ER10393. 99p. NTIS, PC A05/MF A01. Order Number DE81025575.

The report covers the period January 15, 1980 to June 1, 1981 for the research project: An Improved Instrument for the Measurement of Thermal Conductivity of Non-Electrolyte Liquids. The specific objective of the proposed work, currently being funded under Grant DE-AC02-79ER-10393, is to design and construct an innovative transient hot wire thermal conductivity apparatus to measure the thermal conductivity of organic liquids at ambient conditions and at high temperatures and pressures. Specifically, the instrument is to be verified using toluene and the thermal conductivities of two coal liquid fractions are to be determined over a specified range of temperature and pressure. During the current reporting period, which has been extended under a no-cost agreement to September 30, 1981, the following work was conducted: the measuring instrumentation was refined to improve the accuracy of the measuring system; a detailed mathematical description of the apparatus was developed to aid in analysis of the experimental data; the apparatus has been verified with liquid toluene by comparison with measurements reported in the literature; and experimental determinations for coal liquids are currently being made.

29194 (EGG—1183-1802) **Oscillator monitor.** McNeill, G.A. (EG and G, Inc., Las Vegas, NV (USA). Energy Measurements Group). 1 Jul 1981. Contract AC08-76NV01183. 19p. NTIS, PC A02/MF A01. Order Number DE81026255.

Present high-speed data acquisition systems in nuclear diagnostics use high-frequency oscillators to provide timing references for signals recorded on fast, traveling-wave oscilloscopes. An oscillator's sinusoidal wave shape is superimposed on the recorded signal with each cycle representing a fixed time increment. During data analysis the sinusoid is stripped from the signal, leaving a clean signal shape with known timing. Since all signal/time relationships are totally dependant upon working oscillators, these critical devices must have remote verification of proper operation. This manual presents the newly-developed oscillator monitor which will provide the required verification.

29195 (LA-UR—81-1748) **Outsider's look at flight instrumentation.** Lundy, A.S. (Los Alamos National Lab., NM (USA)). 1581. Contract W-7405-ENG-36. 7p. (CONF-810724—1). NTIS, PC A02/MF A01. Order Number DE81025409.

From AIAA/SAE/ASME joint propulsion conference; Colorado Springs, CO, USA (27 Jul 1981).

This paper presents ideas and speculations on possible diagnostic instrumentation for use in missile flight testing. A plea is made for increased instrumentation efforts. There is some discussion of telemetry methods.

29196 (RFP—3188) **Automation of electron diffraction analysis in an analytical electron microscope.** Carr, M.J. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). Jul 1981. Contract AC04-76DP03533. 17p. (CONF-810705—6). NTIS, PC A02/MF A01. Order Number DE81027255.

From 16. annual conference of the Microbeam Analysis Society; Vail, CO, USA (13 Jul 1981).

This paper outlines the concept of gathering and analyzing electron diffraction patterns in an AEM by using a computer to digitally control the operation of a set of post-projector lens scan coils. By digitally controlling the deflection of a static selected area diffraction pattern either to a fixed reference point or in a reduced raster over the apertured STEM detector, a set of electronic signals may be generated which contain information of the form $I = f(x,y)$. Not only can this signal be rapidly processed to provide real-time analyses of diffracted distances and angles of spots in the pattern, but also the operator maintains control over the scanning coils (via joystick) allowing only selected spots to be gathered and analyzed, thus facilitating the analysis of imperfect of multiple patterns. A description of the hardware and software is given, as well as preliminary results and current limitations.

29197 **Fast opening toroidal gas valve.** Myers, B.R.; Levine, M.A.; Shaw, R.S. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). W-7405-ENG-48. *Review of Scientific Instruments ;* **52**: No. 8, 1187-1189(Aug 1981).

A pulsed toroidal gas valve is described. The valve, which has a 10-cm aperture through the center, is designed to be used in toroidal plasma experiments where current-carrying conductors must pass through the axis of symmetry. The valve uses a coil and magnetic flux concentrator to displace an aluminum diaphragm by magnetic forces. Upon energizing the coil, the diaphragm opens in a few tens of microseconds and releases the gas (hydrogen) con-

tained in a toroidal plenum. The resulting gas distribution outside the valve contains up to $10^{19}H_2$ molecules and has a high degree of toroidal symmetry.

29198 **Simple low-temperature press for diamond-anvil high pressure cells.** Shaw, R.W.; Nicol, M. (Department of Chemistry, University of California, Los Angeles, California 90024). E(04-3), PA 88. *Review of Scientific Instruments ;* **52**: No. 7, 1103-1104(Jul 1981).

A simple press for optical spectroscopy in diamond-anvil high pressure cells at 2 K and variable pressure to 10 GPa and higher is described.

4404 Well Logging Instrumentation

REFER ALSO TO CITATION(S) 28193

45 EXPLOSIONS AND EXPLOSIVES

29199 **(UCRL—85614) Correlation of shock-initiation tests for explosives and propellants.** Weston, A.M.; Walton, J.R.; James, E.; Lee, E.; Green, L.G. (Lawrence Livermore National Lab., CA (USA)). Jul 1981. Contract W-7405-ENG-48. 84p. (CONF-810602—31). NTIS, PC A05/MF A01. Order Number DE81026533.

From 7. symposium on detonation; Annapolis, MD, USA (19 Jun 1981).

Comparisons among the shock initiation tests most commonly in use for evaluating explosives and propellants reveal a strong correlation of the results. Lagrange hydrodynamic calculations of the tests are employed to establish the precise nature of the correlation, but we also show how relatively simple approximations to the hydrodynamic results can be used to evaluate shock initiation thresholds. The results of this study provide both an equivalence relationship between the standard tests and a basis for evaluating shock initiation thresholds for hazard conditions in general. The correlations are quite reliably applied to propellants and explosives prepared at a near maximum density. Our analysis of available data shows that the correlation for porous materials is still uncertain.

4501 Chemical

29200 **(LA—8790) Numerical model study of burning and detonation in small PETN-loaded assemblies.** Forest, C.A. (Los Alamos National Lab., NM (USA)). Jul 1981. Contract W-7405-ENG-36. 25p. NTIS, PC A02/MF A01. Order Number DE81028594.

A simple model has been used in the 2DL code to calculate the burning and detonation in Robert Dinegar's all-PETN hot-wire assemblies. The model includes: (1) a constant velocity ignition front; (2) conductive X = BP/sup n/ burn of particles behind the ignition front; (3) inertial confinement; and (4) shock initiation of detonation in the assembly transition tube PETN charge. The surface-to-volume ratio of the burning particles and the ignition front velocity were varied in a parameter study of the model.

29201 **(SAND—80-2438C) Hot-spot initiation of heterogeneous explosives.** Kipp, M.E.; Nonziato, J.W.; Setchell, R.E.; Walsh, E.K. (Sandia National Labs., Albuquerque, NM (USA); Florida Univ., Gainesville (USA)). 1981. Contract AC04-76DP00789. 11p. (CONF-810602—30). NTIS, PC A02/MF A01. Order Number DE81027801.

From 7. symposium on detonation; Annapolis, MD, USA (19 Jun 1981).

It is generally accepted that the shock initiation of heterogeneous explosives begins with the formation of hot spots in the vicinity of microstructural defects such as voids, grain boundaries, and phase boundaries where there can be significant localized deformation as a result of material viscosity, plastic work, and intergranular friction. This phenomenon is described in the context of a recently developed theory of chemically reacting, multiphase mixtures. In particular, we consider a granular explosive with an energetic binder (e.g. PBX-9404) and represent it as a three-phase, saturated mixture consisting of the granular reactant, the binder phase, and the product gases. Under dynamic loading, viscous dissipation results in high temperatures in the binder phase which subsequently thermally explodes to form product gases. Decomposition of the granular reactant is achieved by laminar grain burning. This model has been incorporated into a 1-D Lagrangian finite-difference code (WONDY) and the evolution of compressive shock and acceleration (ramp) waves have been calculated for PBX-9404. The calculated wave growth at the front, as well as the reaction-induced pressure wave behind the wave, are shown to be in good agreement with experimental observations.

29202 **(UCRL—86259) Performance of a 100-kV, 78-kJ electric-gun system.** Chau, H.; Dittbenner, G.; Mikkelsen, K.; Weingart, R.; Froeschner, K.; Lee, R. (Lawrence Livermore National Lab., CA (USA); Kansas State Univ., Manhattan (USA)). 15 Jun 1981. Contract W-7405-ENG-48. 7p. (CONF-810684—24). NTIS, PC A02/MF A01.

From APS conference on shock waves in condensed matter; Menlo Park, CA, USA (23 Jun 1981).

A new electric gun system was constructed for use in high-pressure EOS studies. The system is powered by a 100 kV, 15.6 μF capacitor bank. At 100 kV charging voltage the system inductance is 23 nH. This system has driven 0.3 mm-thick Kapton projectiles to $>$ 20 km/s and 0.3 mm Kapton/30 μm Ta projectiles to $\sim$ 10 km/s. Projectile velocity is modeled phenomenlogically by an electrical Gurney model.

4502 Nuclear

29203 **(LA-UR—81-2136) Improvements to a high-frequency fiber-optic system for plasma diagnostics.** Ogle, J.W.; Lyons, P.B.; Looney, L.; Hocker, L.; Nelson, M.A.; Zagarino, P.A.; Davies, T.J.; Simmons, R.D.; Selk, R.; Hopkins, B. (Los Alamos National Lab., NM (USA); EG and G, Inc., Santa Barbara, CA (USA); EG and G, Inc., Las Vegas, NV (USA)). 1981. Contract W-7405-ENG-36. 7p. (CONF-810810—18). NTIS, PC A02/MF A01. Order Number DE81028741.

From SPIE international symposium; San Diego, CA, USA (24 Aug 1981).

A system for high-frequency recording of plasma diagnostics has previously been reported. Substantial improvements have been made in the system response, dynamic range, and calibration of the system. Plastic-clad silica fiber is used as a radiation-to-light converter using the Cerenkov process. A spectral equalizer device is used to compensate for the material dispersion in the fiber, increasing the frequency response ($\simeq$ 1 GHz-km) and the dynamic range (a factor of $>$ 20 over a FWHM 1 nm, 50% transmitting interference filter). The calibration system uses a pulsed injection laser diode ($<$ 100 ps FWHM) injected into the fiber at the radiation end of the fiber and detected by a microchannel plate photomultiplier tube on the recording end. The injection laser diode is triggered by a synchronous trigger delay unit, which also triggers a sampling or real time scope after as much as 10 μs delay with $<$ 50 ps jitter. The system improvements are described in detail and the utility of these components in other plasma diagnostic systems is discussed.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

REFER ALSO TO CITATION(S) 29238, 29239

29204 **(DOE/EV/12195—41) Oceans and ocean currents: their influence on climate.** Newell, R.E.; Chiu, L.S.; Ebisuzaki, W.; Navato, A.R.; Selkirk, H.B. (Massachusetts Inst. of Tech., Cambridge (USA)). 1980. Contract AS02-76EV12195. 56p. (CONF-8010198—2). NTIS, PC A04/MF A01. Order Number DE81027263.

From Conference on climate and offshore energy resources; London, UK (21 Oct 1980).

Ways in which the oceans influence climate are reviewed. Particular attention is given to influences that may be related to off-

shore energy generation. The role of the ocean currents and seasonal, as well as nonseasonal variations, are discussed. The effects of the Southern Oscillation, a non-seasonal signal in the climate system second only to the Ice Ages, are emphasized. (JGB)

29205 **(UCID—19151) Development and application of computer codes to fill missing meteorological data.** Porch, W.M.; Walton, J.J.; Weidhaas, P.P. (Lawrence Livermore National Lab., CA (USA)). Jul 1981. Contract W-7405-ENG-48. 44p. NTIS, PC A03/MF A01. Order Number DE81025446.

A description is given of the results of a preliminary development of a set of computer codes to fill missing regional scale meteorological data sets to make them continuous. Regional meteorological data have different statistical characteristics depending on the potential application. A general numerical data filling procedure has been developed aimed at preserving the major meteorological statistics as much as possible. Initial tests on a very sparse regional wind data set show encouraging results and tests on a variety of fairly complete control data sets are planned where the data content is randomly decreased.

29206 **(UCRL—50042-80) Annual report of Lawrence Livermore National Laboratory to the FAA on the high-altitude pollution program, 1980.** Luther, F.M. (Lawrence Livermore National Lab., CA (USA)). Dec 1980. Contract W-7405-ENG-48. 99p. NTIS, PC A05/MF A01. Order Number DE81028264.

This annual report documents the progress made on research in support of the High Altitude Pollution Program (HAPP) between October 1, 1979 and December 31, 1980. The primary research emphases at LLNL are numerical modeling of the atmospheric response to stratospheric perturbations and processing and analysis of satellite infrared radiance data to determine global distributions of stratospheric ozone. The modeling effort at LLNL covers three major research areas: photochemical kinetics, coupled kinetics and transport, and radiative transfer. Tasks completed during the past year include: comparison of model simulations of stratospheric composition with observational data, assessments of potential changes resulting from aircraft engine emissions and other perturbations, ozone trend analyses, and assessments of coupled perturbations. The satellite data processing task has three major areas of effort: radiative transfer and ozone retrieval methodology; data processing, archiving, and distribution; and data analysis, interpretation, and quality assurance. Progress in each of these areas is reviewed. Preliminary data from January and February 1979 were processed for comparison with other data. The retrieval methodology has been finalized, and regular data processing will begin in early 1981.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 28086, 28091, 28141, 28617, 28618, 29351

29207 **(BNL—28979) Submicron-particle absorption spectroscopy by photothermal modulation of MIE scattered light.** Campillo, A.J.; Lin, H.B. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 4p. (CONF-810613—7). NTIS, PC A02/MF A01. Order Number DE81025096.

From Conference on lasers and electro-optics; Washington, DC, USA (10 Jun 1981).

In situ particle specific absorption spectroscopy is performed using a CO_2 laser to photothermally modulate visible MIE scattered light. This scheme is appropriate for ambient sulfate particulate analysis.

29208 **(CONF-800989—2) Improved model for natural and mechanical-draft cooling tower plume rise.** Carhart, R.A.; Policastro, A.J.; Wastag, M.; Haake, K. (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG-38. 46p. NTIS, PC A03/MF A01. Order Number DE81023834.

From International Association of Hydraulic Research cooling tower workshop; San Francisco, CA, USA (21 Sep 1980).

Based on previous model validation work, an improved model was developed for single and multiple cooling tower plume rise. The model adopts a one-dimensional integral approach, is applicable to both natural- and mechanical-draft cooling tower plumes and treats the effects of wind direction and variable cross-section on plume merging. Assumptions are made which help resolve the usual difficulties of correctly predicting both plume trajectory and dilution, and of achieving the correct balance of thermodynamic effects. The model treats the effects of tower downwash for both natural- and mechanical-draft plumes by means of additional entrainment and a downward pressure force. The multiple-source plume merging method accounts for different rates of entrainment depending on the degree of non-circularity of the plume cross-section and on the orientation of the merging plumes to the wind direction. The model was calibrated with selected laboratory data (from Battelle Northwest Lab (BNL) and Electricite de France (EDF)) and field data (from Chalk Point, Lunen, Paradise). The model was then verified by comparing its predictions with field data from the Amos and Neurath natural-draft cooling towers (NDCTs), and from the Gaston and Benning Road mechanical-draft cooling towers (MDCTs). Additional verification was provided by model/data comparisons with new single-phase laboratory data from EDF, BNL, and other sources. The overall predictive capability of the model is good.

29209 **(DOE/EP—0019) Coal-fired power plant (western coal): environmental characterization information report.** (Aerospace Corp., Germantown, MD (USA)). Jan 1981. Contract AT03-76EV74010. 67p. NTIS, PC A04/MF A01. Order Number DE81026558.

This Environmental Characterization Information Report (ECIR) for Coal-Fired Power Plants (Western Coal) has been prepared from the latest available environmental and technical information collected from a number of sources. The typical plant chosen for characterization is a 500-MWe pulverized-coal plant burning western low-sulfur ($< 1\%$) coal. The plant uses an electrostatic precipitator, a lime/limestone scrubber, and a wet, mechanical draft cooling tower. The plant fuel is supplied from offsite mines by unit-train deliveries with surface mined, thick seam coal, which undergoes minimum preparation prior to pulverization. The process, plant operating parameters, resources needed, and environmental residuals and products associated with the power plant are presented. In addition to annual quantities, the summary table gives quantities in terms of 10^{12} Btu of electric energy produced. These figures are provided to allow comparison between different energy processes and to facilitate application of the information in computer models. The supporting information and calculation procedures for the data are given. Twenty-three environmental points of interest are quantified and discussed individually, giving a brief description of the pollutants or resources involved, standards to be met, example calculations showing the derivation of quantities, scaling laws and extrapolation methods to adjust to other conditions, and a bibliography of cited references. Specific environmental regulations are discussed in the individual sections. The calculations of allowable emission levels are based on current federal regulations applicable to new plants. Section III discusses the overall physical requirements of the plant for land and water. A glossary of terms and a trace element analysis are included as appendices.

29210 **(DOE/EV/03688—T1) Atmospheric-removal processes for toxic chemicals.** Hanna, S.R.; Hosker, R.P. Jr. (National Oceanic and Atmospheric Administration, Rockville, MD (USA). Environmental Research Labs.). Sep 1980. Contract AI05-76EV03688. 37p. NTIS, PC A03/MF A01. Order Number DE81026624.

Processes effecting the removal of air pollutants from the atmosphere are reviewed. The review includes specific removal methods for trace organic chemical and an application of the box model to account for all removal mechanisms. (ACR)

29211 **(ORNL—5761) PHENIX: a pseudo-spectral model of long-range atmospheric transport.** Murphy, B.D. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 70p. NTIS, PC A04/MF A01. Order Number DE81027628.

A code is described which uses a pseudo-spectral approach in calculating long-range transport and diffusion of atmospheric material. The code has been designed to handle transport from a

number of sources over distances of hundreds to thousands of kilometers. It consequently assumes uniform vertical mixing and is thus a two-dimensional code. The running time for the code is independent of the number of emitting sources. Grid resolution is the determining factor in the code's running time. The current version is designed to handle a horizontal grid of up to 16 x 16; however, it can be easily modified to handle a larger grid. Because it employs a mixed radix fast Fourier transform technique, the grid dimensions are not restricted to being powers of 2. A precursor and successor pollutant pair can be handled by the code which accounts for ground deposition rates of both species, decay rate of the first species and generation and decay rates of the second species. Readily available upper-air wind data are used to generate wind fields; however, the code is structured such that an alternate wind field generator may be employed easily. The code yields output in the form of average ground level concentrations of the precursor and the successor pollutants as well as the total ground deposition pattern for each pollutant.

29212 **Generation and characterization of condensation aerosols of benzo[a]pyrene.** Tu, K.W.; Kanapilly, G.M.; Mitchell, C.E. (Lovelace Biomedical and Environmental Research Inst.; Albuquerque, NM). Contract EY-76-C-04-013. *Journal of Toxicology and Environmental Health ;* **7**: No. 3-4, 353-362(Mar 1981).

Condensation aerosols of benzo[a]pyrene (BaP) with particle sizes ranging from 0.1 to 2 μm (aerodynamic diameter) were produced and studied. These aerosols were generated in a glove box by direct vaporization of BaP and homogeneous condensation of the vapor. The aerosol concentration ranged from 50 to 700 μg/l with aerosol production rates up to 15 mg BaP per minute. The effects of vaporization temperature and flow rate of diluting air on the particle size distribution and aerosol output were studied. The BaP aerosol was produced with relatively constant mass concentration and particle size distribution for more than 5 h. The aerosol was physicochemically and thermally stable. Data on the in vitro dissolution of BaP particles in aqueous solvents and in different dissolution systems suggested that the organic BaP particle does not dissolve in simple aqueous solvents.

29213 **Removal of nitrogen oxides with organic amines and metal complexes.** Kobayashi, H.; Takezawa, N.; Niki, T. (Hokkaido Univ., Sapporo, Japan). *Environment International ;* **4**: No. 4, 273-275(1980).

Aqueous solutions containing organic amines and metal complexes were applied for the removal of nitrogen oxides. Organic amines were effective for the removal of the mixture composed of nitric oxide and nitrogen dioxide. In particular, methyl and ethyl amines removed these species with 1:1 ratio from the mixture at fairly rapid rates. Dinitrogen trioxide (N_2O_3) was suggested to be involved in the course of the removal. Metal complexes removed nitrogen dioxide efficiently. As has been previously reported for a number of inorganic or organic redox systems, it was concluded that the removal of nitrogen dioxide by metal complexes proceeded also by the redox mechanism. Iron(II) chelate complexes were highly effective for the removal of nitric oxide and this was attributed to a reversible coordination to the complex.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 28218, 28273, 29222, 29228, 29338

29214 (CONF-801038—(Vol.2), pp 1084-1094) **$^{14}CO_2$ monitoring with long path length infrared diode laser absorption.** Baronavski, A.P.; Butler, J.E.; Sanders, N.D.; McDonald, J.R. (Naval Research Lab., Washington, DC). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Long path length infrared tunable diode laser absorption spectroscopy is being developed as a technique for monitoring several low energy beta-decay radioisotopes associated with nuclear waste offgases. We will report a determination of sensitivity for $^{14}CO_2$ and an evaluation of potential interferences. Recent experiments have also demonstrated an applicability for measuring iodine isotopes such as $H^{129}I$. Development work will be reported demonstrating the feasibility of also monitoring tritium as TF or TCl.

29215 **(NVO—233) Analysis of UPSHOT-KNOTHOLE 9 (HARRY) radiological and mteorological data.** Quinn, V.E.; Urban, V.D.; Kennedy, N.C. (National Oceanic and Atmospheric Administration, Las Vegas, NV (USA). Weather Service Nuclear Support Office). Apr 1981. Contract AI08-76DP00351. 45p. NTIS, PC A03/MF A01. Order Number DE81028261.

Analyses of the radiological and meteorological data collected for the UPSHOT-KNOTHOLE 9 (HARRY) nuclear test are described. Inconsistencies in the radiological data and their resolution are discussed. The method of estimating fallout arrival times from the meteorological data, and the meteorological situation on D-day and a few days following are described. A comparison of the fallout pattern resulting from these analyses and earlier (1956) analyses is presented. The radiological data used to derive the fallout patterns in this report are tabulated in an appendix.

5005 Site Resource And Use Studies

29216 **(UCRL—85459) Methods for developing seismic and extreme wind-hazard models for evaluating critical structures and equipment at US Department of Energy facilities and commercial plutonium facilities in the United States.** Coats, D.W.; Murray, R.C.; Bernreuter, D.L. (Lawrence Livermore National Lab., CA (USA)). 4 Feb 1981. Contract W-7405-ENG-48. 11p. (CONF-810801—9). NTIS, PC A02/MF A01. Order Number DE81011288.

From 6. international conference on structural mechanics in reactor technology; Paris, France (17 Aug 1981).

Lawrence Livermore National Laboratory (LLNL) is developing seismic and wind hazard models for the US Department of Energy (DOE). The work is part of a three-phase effort to establish building design criteria developed with a uniform methodology for seismic and wind hazards at the various DOE sites throughout the United States. In Phase 1, LLNL gathered information on the sites and their critical facilities, including nuclear reactors, fuel-reprocessing plants, high-level waste storage and treatment facilities, and special nuclear material facilities. Phase 2 - development of seismic and wind hazard models - is discussed in this paper, which summarizes the methodologies used by seismic and extreme-wind experts and gives sample hazard curves for the first sites to be modeled. These hazard models express the annual probability that the site will experience an earthquake (or windspeed) greater than some specified magnitude. In the final phase, the DOE will use the hazards models and LLNL-recommended uniform design criteria to evaluate critical facilities. The methodology presented in this paper also was used for a related LLNL study - involving the seismic assessment of six commercial plutonium fabrication plants licensed by the US Nuclear Regulatory Commission (NRC). Details and results of this reassessment are documented in reference.

5006 Regulations

REFER ALSO TO CITATION(S) 28155, 28590, 28615

29217 (CONF-810498—(Vol.2), pp 1101-1122) **Environmental licensing of coal/oil mixtures.** Kosky, K.F. (Environmental Science and Engineering, Inc., Gainesville, FL); Schumacher, A.M.; Allen, R.N. 1981. NTIS, PC A99/MF A01.

From 3. international symposium on coal-oil mixture combustion; Orlando, FL, USA (1 Apr 1981).

Environmental requirements for licensing alternate fuels have changed substantially in recent years. Because of the complexity of today's environmental regulations, proper awareness is needed to successfully license the use of coal/oil mixtures. This paper presents a brief description of environmental regulations and potential effects of those requirements on the use of coal/oil mixtures. The environmental requirements are based on data developed for a coal/oil mixture test on a 400-MW oil-fired unit. The test was conducted in Sanford, Florida, by Florida Power and Light Company (FPL) to determine the feasibility of burning up to 50 percent

coal mixed in oil. The discussion includes requirements for: (1) Air-Prevention of Significant Deterioration (PSD) and New Source Performance Standards (NSPS), (2) Water-National Pollution Discharge Elimination System (NPDES), and (3) Land-Resource Conservation and Recovery Act (RCRA). The air pollution requirements can be most substantial, depending upon regulatory decisions involving Best Available Control Technology (BACT) or the applicability of new source performance standards. Such determinations will have an effect on the feasibility of utilizing coal/oil mixtures on existing units. These requirements can also have a significant time consequence. Typical licensing can take from 12 to 24 months.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

REFER ALSO TO CITATION(S) 29237

29218 **Effects of litter alteration on carbon dioxide evolution from a South Caroline pine forest floor.** Reinke, J.J.; Adriano, D.C.; McLeod, K.W. (Savannah River Ecology Lab., Aiken, SC). Contract EY-76-C-09-0819. *Soil Science Society of America Journal ;* **45**: No. 3, 620-623(May 1981).

A field study in the upper Coastal Plain of South Carolina was conducted to evaluate the impacts of several litter manipulations on carbon dioxide evolution from a longleaf pine (Pinus palustris Mill.) forest floor. These manipulations, which included prescribed burning, removal of the L-layer material (red straw), and total litter (01 and 02 horizons) removal, were compared with undisturbed control treatment using a static alkali absorption technique for CO_2 measurement. Though slight reductions were noted, the burning and removal of the L-layer material had less effect on the evolution of CO_2 from the forest floor than total litter removal. Total litter removal, however, significantly reduced the average rate of CO_2 evolution by approximately 22% ($p \leq 0.05$). The amount of CO_2 evolved was sensitive to rainfall and air temperature, showing declines in periods of drought and cool temperature. However, on an annual basis, the air temperature was much more important than rainfall in estimating the CO_2 evolution. The burning treatment increased the pH and nitrogen concentrations of the litter and the soil pH at the 0 to 5-cm depth. The calculated net annual respiration (CO_2-C production), exclusive of root metabolism, was approximately equivalent to 95% of the C input from litterfall deposited on the ground during this period, indicating that perhaps the accumulation of litter has reached a steady state condition.

29219 **Carbon flux to surface mineral soil after Nitrogen and Phosphorus fertilization.** Kelly, J.M. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Soil Science Society of America Journal ;* **45**: No. 3, 669-670(May 1981).

The movement of organic carbon into the mineral soil profile was increased by a factor of 2 to 3 following urea application to the forest floor. Approximately 74% of the organic carbon movement occurred during the first 3 months following treatment. Phosphorus treatment and the interaction of nitrogen and phosphorus did not produce a statistically significant response.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 29357

29220 **(DOE/EV/04498—1) Effects of acid precipitation on cation transport in New Hampshire forest soils. Technical completion report.** Cronan, C.S. (Maine Univ., Orono (USA). Land and Water Resources Inst.). Jul 1981. Contract AS02-77EV04498. 51p. NTIS, PC A04/MF A01. Order Number DE81027494.

This report describes the results of our investigation of the effects of regional acid precipitation on forest soils and watershed biogeochemistry in New England. The report provides descriptions of the following research findings: (1) acid precipitation may cause increased aluminum mobilization and leaching from soils to sensitive aquatic systems; (2) acid deposition may shift the historic carbonic acid/organic acid leaching regime in forest soils to one dominated by atmospheric H_2SO_4; (3) acid precipitation may accelerate nutrient cation leaching from forest soils and may pose a particular threat to the potassium resources of northeastern forested ecosystems; (4) while acid rain may pass through some coniferous canopies without being neutralized, similar inputs of acid rainfall to hardwood canopies may be neutralized significantly by Bronsted base leaching and by leaf surface ion exchange mechanisms; and (5) progressive acid dissolution of soils in the laboratory may provide an important tool for predicting the patterns of aluminum leaching from soils exposed to acid deposition.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 28265, 28275, 28277, 28306, 28308, 28310, 28311, 29250, 29251, 29338, 29357

29221 **(CONF-810730—1) Low-level waste shallow burial assessment code.** Fields, D.E.; Little, C.A.; Emerson, C.J. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 6p. NTIS, PC A02/MF A01. Order Number DE81025172.

From 1981 national conference on environmental engineering; Atlanta, GA, USA (8 Jul 1981).

PRESTO (Prediction of Radiation Exposures from Shallow Trench Operationns) is a computer code developed under United States Environmental Protection Agency funding to evaluate possible health effects from radionuclide releases from shallow, radioactive-waste disposal trenches and from areas contaminated with operational spillage. The model is intended to predict radionuclide transport and the ensuing exposure and health impact to a stable, local population for a 1000-year period following closure of the burial grounds. Several classes of submodels are used in PRESTO to represent scheduled events, unit system responses, and risk evaluation processes. The code is modular to permit future expansion and refinement. Near-surface transport mechanisms considered in the PRESTO code are cap failure, cap erosion, farming or reclamation practices, human intrusion, chemical exchange within an active surface soil layer, contamination from trench overflow, and dilution by surface streams. Subsurface processes include infiltration and drainage into the trench, the ensuing solubilization of radionuclides, and chemical exchange between trench water and buried solids. Mechanisms leading to contaminated outflow include trench overflow and downwad vertical percolation. If the latter outflow reaches an aquifer, radiological exposure from irrigation or domestic consumption is considered. Airborne exposure terms are evaluated using the Gaussian plume atmospheric transport formulation as implemented by Fields and Miller (1980).

29222 **(DOE/EP—0023) Guide for: environmental radiological surveillance at US Department of Energy installations.** Corley, J.P.; Denham, D.H.; Jaquish, R.E.; Michels, D.E.; Olsen, A.R.; Waite, D.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1981. Contract AC06-76RL01830. 215p. NTIS, PC A10/MF A01. Order Number DE81027833.

This second edition of the Guide, originally published in 1977, is presented as an interim revision and does not contain major changes in content. The original objectives and scope of the Guide have not changed. The Guide is intended to: provide recommended methods, procedures, and performance criteria to bring greater comparability to DOE environmental monitoring and reporting systems; provide DOE management, particularly the Headquarters' Operational and Environmental Safety Division (OESD) and field offices, with a broad review of accepted radiological surveillance practices for use in the evaluation of environmental surveillance programs at DOE facilities; and delineate the capabilities and limitations of the various environmental monitoring systems for radioactivity currently used at DOE sites, including technical areas where there is either an inadequate basis for procedural selection or where further development work may be warranted. The document is intended as a guide, not a manual of detailed mandatory procedure. (JGB)

29223 (DP—1591) Lysimeter tests of SRP waste forms. Hooker, R.L.; Root, R.W. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). May 1981. Contract AC09-76SR00001. 49p. NTIS, PC A03/MF A01. Order Number DE81027127.

A field study, estimated to last 10 years, has been started to define leaching and migration rates of radionuclides from typical SRP buried wastes. The study utilizes 42 lysimeters (6-ft or 10-ft diameter by 10-ft deep) which have been charged with soil and waste to simulate burial ground conditions. Eight waste forms were selected for the study, which represent the bulk of the wastes generated at SRP. This report describes the lysimeter design, the physical and radiological characteristics of the wastes, and the experimental approach. Calculations have also been made which predict the migration of various radionuclides in the lysimeter soil. The calculations should provide guidance during the course of the study, and are the basis of recommendations made for collecting and interpreting data so that important parameters of migration can be evaluated.

29224 (EPA—600/4-81-035) User's guide for survey-meter- and film-badge-dosimetry data bases. Phillips, W.G.; Sherman, S.; Young, R. (Environmental Protection Agency, Las Vegas, NV (USA); Nevada Univ., Las Vegas (USA)). May 1981. Contract AI08-76DP00539. 29p. (DOE/DP/00539—041). NTIS, PC A03/MF A01. Order Number DE81028785.

This manual describes the data storage and retrieval system designed by Environmental Monitoring Systems Laboratory Las Vegas (EMSL-LV) for radiation exposure data recorded in offsite areas during and after nuclear weapons tests conducted at the Nevada Test Site in the 1950's and early 1960's. Referred to hereinafter as the EMSL-LV system, this system contains two distinct subsets of offsite radiological measurements collected during early nuclear atmospheric tests at the Nevada Test Site. The purpose of the manual is to present the methods for using the EMSL-LV system to examine all or any portion of either data subset. The two distinct subsets which comprise the EMSL-LV system are survey meter data and film badge dosimetry data. The survey meter data consist of readings obtained from portable radiation monitoring instruments used around the Nevada Test Site during the 1950's and early 1960's to measure radiation exposure rates resulting from the nuclear testing program. The dosimetry data consist of measurements of integrated radiation exposure made with film badge type dosimeters in areas surrounding the Nevada Test Site.

29225 (GJBX—146-81) Study of the radon released from open drill holes. Pacer, J.C. (Bendix Field Engineering Corp., Grand Junction, CO (USA). Grand Junction Operations). Jun 1981. Contract AC13-76GJ01664. 25p. NTIS, PC A02/MF A01. Order Number DE81027987.

The radon emanating from three open drill holes was measured at a site of known uranium mineralization in the Red Desert of south central Wyoming. The radon flux from the soil and drill holes was measured by the accumulator method with activated charcoal cartridges. The surface soil was found to release radon at an average rate of 0.41 atoms/cm^2/sec; the radon emanating from the holes was more variable than that from the soil. The three holes studied released an average of 47 atoms/cm^2/sec of radon. This average is equivalent to the radon released to the atmosphere by 14.5 ft^2 of soil. The data indicate that the radon emanated from an open drill hole is not as significant as other possible activities at a drill site (i.e. digging a trench or drilling a hole) or from household activities involving the usage of water.

29226 (PNL—3834) ALARA dosimetry study for non productive radiation exposures in Pacific Northwest Laboratory facilities. Hadlock, D.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Apr 1981. Contract AC06-76RL01830. 21p. NTIS, PC A02/MF A01. Order Number DE81027838.

A special ALARA study was conducted during 1980 in selected Pacific Northwest Laboratory facilities. The study utilized thermoluminescent dosimeters (TLDs) which were designed to detect gamma, beta, and neutron exposures; however, only gamma exposures are evaluated in this report. The processing of ALARA (As Low As Reasonably Achievable) dosimeters was performed by the Dosimetry Technology Section of the Radiological Sciences Department. Evaluation of dosimetry data and locations was performed in conjunction with the Radiation Monitoring Section and the Radiological Safety and Engineering Section of the Occupational and Environmental Protection Department. This study was prompted by a DOE-RL directive to reduce radiation exposure to As Low As Reasonably Achievable (ALARA) with a goal of no personnel whole-body penetrating exposures exceeding 3 rem for calendar year 1980. The purpose of this study was to characterize the background radiation environment at selected locations within PNL facilities. Attention was focused on non productive radiation exposure received from the work environment.

29227 (RFP—3197) Health, Safety and Environment Department, Environmental Sciences Branch. Progress report, January-June 1980. Siciliano, C.L. (ed.). (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 10 Jul 1981. Contract AC04-76DP03533. 44p. NTIS, PC A03/MF A01. Order Number DE81027696.

A summary is presented of activities of the Environmental Studies and Environmental Analysis Groups during the period January through June 30, 1980. Four major projects are reported; namely, dust transport including filter efficiency studies, distribution of transuranics in sediment, critical ecological pathways for radionuclides, and ecosystem compartmentalization of transuranics. Progress is described for the special programs dealing with management of open space lands at Rocky Flats, assurance of quality in environmental monitoring measurements, assessment of epidemiological studies of health effects purported to be related to the Plant, and evaluation of environmental monitoring data. Some of the reported project activities on Rocky Flats Plant site include studies of: airborne dust concentration and specific americium-241 activity in the field east of the asphalt pad; vertical fluxes of dust in the same field; vertical sediment sampling profiles of plutonium-239, -240 and americium-241 in the Great Western Reservoir spillway; radiological sediment sampling of water bodies on and near the Plant site; measured frequency and coverage values of representative plant species and their importance values for two test plots near the Plant; transuranic specific activities of vegetation from the same two test plots; airborne deposition and root uptake of transuranics by plants at the Lindsay Ranch Pond and the greenhouse site; and tissue analysis (for transuranics) of deer road-killed near or on the Plant site.

29228 (RHO-LD—81-75) Effluent Controls Group annual report: CY 1980. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Jun 1981. Contract AC06-77RL01030. 163p. NTIS, PC A08/MF A01. Order Number DE81025585.

Solid, liquid, and airborne discharges of radioactive and other hazardous materials to the Hanford environs from Rockwell Hanford Operations (Rockwell) are reported and compared with applicable release standards. A summary of the 1980 discharges is presented. The discharge values for airborne and liquid effluents are reported. The disposal of radioactive and nonradioactive solid wastes is reported. Nonroutine releases which occurred during calendar year 1980 are described.

29229 (RHO-SA—181) Risk assessment for determination of in-situ data requirements. Wood, D.E. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Oct 1980. Contract AC06-77RL01030. 8p. (CONF-801103—60). NTIS, PC A02/MF A01. Order Number DE81026578.

From IEEE nuclear science symposium; Orlando, FL, USA (5 Nov 1980).

The use of formal risk assessment techniques to determine in-situ data needed for nuclear waste disposal sites is discussed. Considerations of accident sequences, transport pathways to the biosphere, and dose factors lead to identification of the radionuclides which contribute to potential public radiation exposure as a function of time. Generic risk assessments have identified ^{14}C, ^{90}Sr, ^{99}Tc, ^{129}I, ^{137}Cs, ^{226}Ra (from ^{238}U), ^{237}Np, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, and ^{241}Am as nuclides of interest. Site-specific studies can establish the relative importance of each and thus the precision

needed for measurement of nuclide inventory and distribution. Instrumentation needs can then be established for measurement of these nuclides. The presence of low-energy beta emitters and several actinides on the list offers considerable challenge for instrument developers.

29230 **(SAND—81-0395C) Asymptotic behavior of a model for the environmental movement of radionuclides.** Helton, J.C.; Brown, J.B.; Iman, R.L. (Sandia National Labs., Albuquerque, NM (USA); Arizona State Univ., Tempe (USA); Auburn Univ., AL (USA)). 1981. Contract AC04-76DP00789. 24p. (CONF-810372—7). NTIS, PC A02/MF A01. Order Number DE81027204.

From Symposium on uncertainties associated with the regulation of the geologic disposal of high-level radioactive waste; Gatlinburg, TN, USA (9 Mar 1981).

The Environmental Transport Model is used to represent the surface movement of radionuclides. This presentation provides an indication of the results obtained in a study of the asymptotic behavior of this model. The nature of the Environmental Transport Model is indicated and its asymptotic behavior is discussed. Then, an approach to sensitivity analysis of this behavior is outlined and the partial results of such an analysis are presented.

29231 **(SAND—81-0566) 1980 environmental monitoring report, Sandia National Laboratories, Albuquerque, New Mexico.** Millard, G.C.; Simmons, T.N.; Gray, C.E.; O'Neal, B.L. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1981. Contract AC04-76DP00789. 27p. NTIS, PC A03/MF A01. Order Number DE81027839.

Sandia National Laboratories in Albuquerque is located south of the city on two broad mesas. The local climate is arid continental. Radionuclides are potentially released from five technical areas from the Laboratories' research activities. Sandia's environmental monitoring program searches for cesium-137, tritium, uranium, alpha emitters, and beta emitters in water, soil, air, and vegetation. No activity was found in public areas in excess of that found in local background in 1980. The Albuquerque population receives only 0.11 person-rem (estimated) from airborne radioactive releases. While national security research is the Laboratories' major responsibility, energy research is a major area of activity. Both these research areas cause radioactive releases.

29232 **Device for the measurement of ^{227}Ac in solid samples.** Crawford, D.J.; Frazier, W.K.; Reynolds, B.A.; Patch, K.D.; Haywood, F.F.; Goldsmith, W.A.; Perdue, P.T.; Berven, B.A. (Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Review of Scientific Instruments ;* **52**: No. 8, 1240-1242(Aug 1981).

A technique has been developed for the determination of ^{227}Ac concentration in soil samples. Emanating ^{219}Rn is introduced into an air stream and passed through a two-filter decay tube similar to that reported by Thomas and LeClare for ^{222}Rn [Health Phys. 18, 113 (1970)]. Experimental tests and theoretical calculations indicate the technique to be sensitive at a level of 2 pCi/g with a 95% confidence level. Relevant empirical and theoretical considerations are discussed.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 28096, 28275, 28276, 28291, 29240, 29252

29233 **(PNL—3737) Economic feasibility analysis of water-harvesting techniques for mined-land reclamation.** Nieves, L.A.; Marti, M.H. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1981. Contract AC06-76RL01830. 47p. NTIS, PC A03/MF A01. Order Number DE81028262.

A water harvesting, agricultural production system, field tested as a means of reclaiming strip-mined land is described. Though the technical feasibility of the system is becoming increasingly apparent, economic feasibility and legal issues may determine its potential application. The purpose of this study is to explore the economic feasibility of the system and to provide information for use in assessing whether further investigation of water harvesting reclamation techniques is warranted. The economic feasibility of the PNL reclamation system hinges on whether its net benefits exceed those of conventional reclamation. This preliminary feasibility study assesses the net private benefits of each system using data for the Peabody Coal Company's Kayenta mine on the Black Mesa in Arizona. To compare the alternative reclamation systems, the present value of direct net benefits (income minus production and reclamation costs) is calculated for grazing (conventional reclamation) or for cropping (PNL reclamation). Three of the PNL system slope treatments have lower estimated total costs than conventional reclamation. The difference is $3895/acre for compacted slope, $3025/acre for salt-compacted slope and $2310/acre for crop-on-slope. These differences constitute a substantial cost advantage for the system on the basis of the present value of land reclamation and maintenance costs. The system also has advantages based on the estimated value of agricultural production capacity. Even the lowest yield levels considered for alfalfa, corn, and pinto beans had higher net present values than grazing.

29234 **(UCRL—15364-Add.) Cultural resource inventory of Lawrence Livermore National Laboratory's Site 300, Alameda and San Joaquin Counties, California.** Busby, C.I. (Lawrence Livermore National Lab., CA (USA); Basin Research Associates, Inc., Hayward, CA (USA)). May 1981. Contract W-7405-ENG-48. 262p. NTIS, PC A12/MF A01. Order Number DE81026586.

The appendices to the Cultural Resource Inventory contain miscellaneous correspondence, site type definitions, BLM Cultural Resources Evaluation System (CRES), sample unit forms, site forms, and photographic record forms. (ACR)

5106 Regulations

REFER ALSO TO CITATION(S) 29217

29235 **(DOE/PC/30162—T1) Reclamation permit application handbook. Final technical report.** Myers, L.L.; Calvert, R.P. (Mining and Reclamation Council of America, Washington, DC (USA)). Jun 1981. Contract AC22-80PC30162. 61p. NTIS, PC A04/MF A01. Order Number DE81027098.

The objective of this handbook is to provide Appalachian surface coal mine operators with an explanation of the Office of Surface Mining's (OSM) permanent regulatory program permit application requirements. The format of the handbook is designed to give the reader an understanding of how the permit application regulations were developed, the number of subjects the application must cover, the work entailed in satisfying the permit requirements, and sources of information for more technical studies. Preparation of the handbook involved reviewing the OSM regulations and devising a hypothetical permit, incorporating information required by all the sections of the regulations. The outlines and drafts of the handbook were reviewed by mine operators, OSM, and State agencies for completeness, and to ensure that the maximum benefit would be derived by using such a handbook.

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

29236 **(CONF-810701—5) Spatial patterning and error propagation in a stream-ecosystem model.** Gardner, R.H.; O'Neill, R.V.; Carney, J.H. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 18p. NTIS, PC A02/MF A01. Order Number DE81026519.

From Computer simulation conference; Washington, DC, USA (15 Jul 1981).

In many cases an aggregated model can adequately represent overall properties of a spatially distributed system. The present study examines whether such a lumped model can provide reliable estimates of the uncertainty associated with predictions. For this purpose we compared standard deviations associated with predic-

tions from a spatially distributed and a spatially lumped model of the same stream ecosystem. We examined the ability of the lumped model to estimate the uncertainties predicted from the distributed model. Three sources of spatial patterning were examined: internal dynamics of the stream, patterns of litter inputs, and patterns in initial conditions. The aggregated model was least reliable when spatial patterns were due to internal dynamics of the distributed system; estimated standard deviations were as much as 2.5 times too large. Ignoring spatial patterns in system inputs and initial conditions caused less serious problems, but results were complicated by nonlinearities and interaction terms in the models. In all cases examined, spatial patterning significantly affected the uncertainty associated with model predictions.

29237 Spin-up model as a diagnostic tool for interpretation of current and density measurements on the continental shelf of the Pacific Northwest. Hickey, B.M. (Univ. of Washington, Seattle); Hamilton, P. *Journal of Physical Oceanography ;* **10**: No. 1, 1-13(Jan 1980).

The primary goal of this paper is to prescribe the practical limitations of the two-dimensional, baroclinic, time-dependent model of Hamilton and Rattray (1978) for the Oregon-Washington continental shelf. A unique time series of density sections at approximately 3-day intervals over a 5-week period makes the test possible. The Columbia River effluent was modeled by a surface freshwater flux that allowed the plume to become detached from the coast during periods of northerly winds. Energy levels and phases of fluctuations in longshore currents and sea level could be effectively predicted with a vertically averaged version of the two-dimensional model whose essential longshore dynamics are a balance between local acceleration (multiplied by shelf depth), surface friction and bottom friction. With respect to simulation of the density field, the two-dimensional model was effective in predicting offshore displacement of surface isopycnals and vertical displacement of isopycnals below the surface layer for periods as long as 15 days. Significant non-local effects were observed twice in 30 days. Some improvement in agreement for deeper isopycnals was obtained when barotropic non-local effects were included by driving the model with h delta ν bar/delta t, where h is the shelf depth and ν bar the depth-mean current. This function, which almost exactly reproduces the barotropic longshore current, is based on an observed time-scale separation between wind stress and current.

29238 (HIG—80-7) Meteorological observations in the Line Islands, 1972-1980. Vitousek, M.J.; Kilonsky, B.; Leslie, W.G. (Hawaii Univ., Honolulu (USA). Hawaii Inst. of Geophysics). Dec 1980. 81p. Hawaii Institute of Geophysics, Honolulu. Order Number DE81903420.

As part of the NORPAX program of the International Decade of Ocean Exploration, an air and sea monitoring program was strategically established in the center of the Pacific Ocean on the Line Islands. The report describes the location of the monitoring stations, the parameters measured, the instruments used, and the data processing methods employed. Finally, the data are presented graphically through computer plots and certain areas of interest are indicated. The analysis of the data will appear in future reports. The data set is available on computer tape.

29239 Role of the littoral zone and detritus in lake metabolism. Wetzel, R.G. (Michigan State Univ., Hickory Corners). Contract EY-76-S-02-1599. *Archiv fuer Hydrobiologie ;* **13**: 145-161(Dec 1979).

Major physiological and ecological characteristics of emergent, freely-floating, floating-leaved, and submersed angiosperms are discussed in relation to productivity of lake systems. The macrophytic communities and attendant epiphytic microflora function as effective metabolic sieves for influent inorganic nutrients and dissolved organic compounds. In a majority of the lakes of the world, the lake ontogeny develops through four distinct phases: (1) early stages under nutrient limitation in which phytoplankton productivity is coupled with an increasingly productive complex of submersed macrophytes and epiphytic algae; (2) an intermediate stage of system productivity in which maximal phytoplanktonic productivity eliminates submersed macrophytes and most attached algae by shading and in which that of wetland and littoral emergent vegetation expands; (3) maximal productivity of the systems associated with dominance of emergent macrophytes; and (4) precipitously declining productivity accompanying the transition from wetland to terrestrial conditions under increasing limitations of available water. In most lake systems, even though photosynthetic inputs of dissolved and particulate organic matter from littoral and allochthonous sources are pulsed seasonally, decomposition is delayed temporally by environmental factors and spatially by displacement to the sediment and to zones of the water column where rates are slowed. The cumulative result is an inherent stability of lake metabolism provided by the massive detrital base upon which the living biotic communities operate. As the ontogeny shifts towards greater dominance by emergent aquatic macrophytes, the increasing contribution of derivatives of lignified, and cellulosic tissue leads to accelerated rates of sedimentation and enhancement of emergent communities. Several mechanisms involved in reduced rates of decomposition are discussed in relation to this accelerating enhancement.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 28095, 28177, 29060, 29252, 29357

29240 (ANL/EMR—2Vol.3) Environmental control technology survey of selected US strip mining sites. Volume 3. Control technology. Bogner, J.E.; Schubert, J.P.; Kaszynski, G.M. (Argonne National Lab., IL (USA)). Feb 1981. Contract W-31-109-ENG-38. 280p. NTIS, PC A13/MF A01. Order Number DE81027531.

The environmental control technology for maintaining water quality at 21 surface mines in eastern and central US coalfields is summarized. The mines ranged from small contour-mining operations to large area mines. Seven mines used chemical reagents to neutralize acid effluents in order to conform to federal regulations. The remaining 14 mines used only settling ponds, in an effort to reduce concentrations of suspended solids. Because effluent discharges at surface coal mines do not remain in the same places over long periods of time, and because discharges are generally small (<5 gal/min) and variable, surface mine operators favor small, efficient, portable systems for applying neutralization reagents. Reagent cost is less important to surface coal mine operators than is the labor cost required for reagent application and handling. Thus, small caustic soda and soda ash treatment systems are common, even though the cost of these reagents (based on treating water of equivalent acidity) may be several times that of hydrated lime or limestone treatment. Water chemistry data indicated that the mines achieved varying degrees of success with their control technology. Costs of water treatment are expected to rise in response to enforcement of the final federal regulations for coal mine effluents; these increases will be greater in the Appalachian region than in the central United States. Surface mine operators should concentrate on pre-mining planning in order to minimize pyrite oxidation and resulting acid mine drainage. Preventing generation of poor-quality effluents, rather than maintaining treatment facilities during and after mining, could result in long-term cost savings.

29241 (DOE/EV/04047—T1) Assessment of treated vs. untreated oil spills. Final report. (Rhode Island Univ., Kingston (USA). University Energy Center). Dec 1980. Contract AS02-76EV04047. 1042p. (COO—4047-005). NTIS, PC A99/MF A01. Order Number DE81023130.

This report describes the results of a series of studies conducted to determine the practicability and feasibility of using dispersants to mitigate the impact of an oil spill on the environment. The method of approach is holistic in that it combines the physical, chemical, microbial and macro-fauna response to a spill treated with dispersants and compares this with spills that are left untreated. The program integrates mathematical, laboratory, meso-scale (three 20 foot high by three feet in diameter tanks, described in Section 1), in-situ experiments and analyses to determine if the use of dispersants is an effective oil spill control agent. Appendices include sections on: error analysis; measurement of interfacial tension; computer programs; distinction between crude oil and dispersant by means of infrared spectroscopy; a computer manual for URI oil spill model; a description of computer software; colony types of bacterial isolates; and replica plating. Separate abstracts have been prepared for 9 individual studies for inclusion in the Energy Data Base.

29242 **(LBL—11411) Assessment of optimum aquatic microcosm design for pollution-impact studies. Final report.** Harte, J.; Levy, D.; Rees, J.; Saegebarth, E. (Lawrence Berkeley Lab., CA (USA)). Sep 1980. Contract W-7405-ENG-48. 170p. NTIS, PC A08/MF A01. Order Number DE81028547.

A series of experiments was carried out to determine and evaluate optimum design and operating conditions for pelagic lake microcosms (microcosm assessment studies) and to explore a possible use of such systems for toxicological testing (decomposition studies). Criteria selected for microcosm optimization were realism (tracking by the microcosms of the real lake used to stock the microcosms) and replicability of identically-initiated microcosms. In the assessment studies, a number of different pelagic microcosm configurations were studied, including the size of the microcosm containers (from 4 liters to 200 liters), the method of algal surface-growth prevention, and the degree of water mixing and aeration. In addition, the microcosm-lake comparisons were carried out at various seasons of the year, allowing us to determine the influence of natural seasonal factors on the chemical and biological differences between the lakes and the microcosms.

29243 **(UCRL—85468) Ground-water effects of the UCG experiments at the Hoe Creek site in northeastern Wyoming.** Mead, S.W.; Wang, F.T.; Stuermer, D.H. (Lawrence Livermore National Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 22p. (CONF-810909—2). NTIS, PC A02/MF A01. Order Number DE81023660.

From Institute of Gas Research conference; Los Angeles, CA, USA (28 Sep 1981).

Ground-water changes and subsidence effects associated with three underground coal gasification (UCG) experiments have been monitored at the Hoe Creek site in northeastern Wyoming. Ground-water quality measurements have extended over a period of four years and have been supplemented by laboratory studies of contaminant sorption by coal. It was found that a broad range of residual gasification products are introduced into the ground-water system. These contaminants may be of environmental significance if they find their way, in sufficient concentrations, into surface waters, or into aquifers from which water is extracted for drinking or agricultural purposes. Fortunately, the concentrations of these contaminants are substantially reduced by sorption on the surrounding coal. However, recent field measurements indicate that there may be significant limitations on this natural cleansing process. The contaminants of potential concern, and the mechanisms that affect their deposition and persistence have been identified.

29244 **(Y/DU—113) Results of Weldon Spring technical support for FY-1980.** Taylor, P.A. (Oak Ridge Y-12 Plant, TN (USA)). 21 Nov 1980. Contract W-7405-ENG-26. 10p. NTIS, PC A02/MF A01. Order Number DE81027612.

A new sample of solution was collected from Pond 3 at the Weldon Spring site on July 10, 1980. This sample contained 2.15% NO_3^- which was substantially higher than the previously measured values of 1.1 to 1.4% NO_3^-. The radium concentration of this sample was 200 pCi $^{226}Ra/L$ which compares well with the previously measured value of 195 pCi $^{226}Ra/L$. A beaker-scale experiment has shown radium adsorption by bacteria naturally present in Pond 3. It took eight months for the bacteria to reduce the nitrate concentration to below 50 mg/L. By this time the bacteria had adsorbed 98.6% of the radium originally present in the solution.

29245 **Oily water discharges: regulatory, technical and scientific considerations.** Johnston, C.S.; Morris, R.J. (eds.). London, England; Applied Science Publishers Ltd. (1980). 240p. (CONF-780620—).

From Conference on oily water discharges; Edinburgh, UK (28 Jun 1978).

This book contains papers presented at a seminar to consider the potential environmental risk from the discharge of oil water effluents. It covers the following topics: the Paris Convention and its relation to North Sea Oil Developments; sources and effects of oil in the marine environment; control technology/performance at the new onshore oil terminals and offshore installations; criteria and methodology for monitoring oil water emission. Separate abstracts have been prepared for each paper for inclusion in the Energy Data Base. (DMC)

29246 **Fluorescence: absorbance ratios - a molecular-weight tracer of dissolved organic matter.** Contract EY-76-S-02-1599. *Limnology and Oceanography ;* **25**: No. 3, 559-564(1980).

Naturally occurring dissolved humic materials were fractionated according to molecular weight by dialysis and gel permeation chromatography. Components of higher molecular weight (> 3500) absorbed strongly at 250 nm but fluoresced weakly, while humic fractions of lower molecular weight fluoresced intensely per unit absorbance. With appropriate precautions, fluorescence: absorbance ratios may be useful in delineating seasonal and depth distribution patterms of dissolved humic materials of low and high molecular weight.

29247 **Genetic heterogeneity within an electrophoretic phenotype of phosphoglucose isomerase in a Japanese population.** Satoh, C.; Mohrenweiser, H.W. (Univ. of Michigan Medical School, Ann Arbor). *Annals of Human Genetics ;* **42**: 283-292(1979).

Human erythrocyte phosphoglucose isomerase (GPI), D-glucose-6-phosphate ketol isomerase (E.C. 5.3.1.9), also referred to as phosphohexose isomerase or glucose phosphate isomerase, is a dimeric enzyme with a molecular weight of 132000. In a study of Japanese residing in Hiroshima and Nagasaki, 5 electrophoretic variant phenotypes were observed in 35 unrelated individuals in a sample of 4029 observations. In the present paper, the thermostability of erythrocyte GPI from 27 individuals representing the five variant phenotypes will be described.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 29222, 29223, 29228, 29229, 29230, 29244

29248 **(CONF-810722—5) Comparative food-chain behavior and distribution of actinide elements in and around a contaminated fresh-water pond.** Garten, C.T. Jr.; Trabalka, J.R.; Bogle, M.A. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 21p. NTIS, PC A02/MF A01. Order Number DE81026522.

From International symposium on migration in the terrestrial environment of long-lived radionuclides from the nuclear fuel cycle; Knoxville, TN, USA (27 Jul 1981).

The bioaccumulation of ^{233} ^{234}U, ^{238}U, ^{238}Pu, ^{239} ^{240}Pu, ^{241}Am, and ^{244}Cm in both native and introduced biota was studied at Pond 3513, a former low-level radioactive waste settling basin at Oak Ridge National Laboratory. This system, which was decommissioned in 1976 after more than 30 years use, contains approximately 5 Ci of ^{239} ^{240}Pu; inventories of other actinide isotopes are considerably less. Significantly higher concentrations of actinides in fish that were allowed access to sediments indicated that sedimentary particulates may be the primary source of transuranics to biota in shallow fresh-water ecosystems. Our study determined habitat, in particular the degree of association of an organism with the sediment-water interface, to be the primary factor in controlling transuranic concentrations in aquatic biota. In most of the biological samples analyzed, excluding samples suspected of being contaminated by sediment, $^{241}Am/^{239}Pu$, $^{244}Cm/^{239}Pu$, and $^{238}U/^{239}Pu$ ratios were greater than the respective ratio in sediment while ^{233} $^{234}U/^{238}U$, and ^{239} $^{240}Pu/^{239}Pu$ ratios were not different from the respective ratios in sediment. The relative uptake of actinides from contaminated sediment by aquatic and terrestrial biota at this site was $U > Cm \geqq Am > Pu$. The relative extractability of actinides from shoreline sediment was $U > Cm \approx Am > Pu$; we also observed the same relative ranking for sediment-water exchange in situ. Concentrations of transuranics in water, terrestrial vegetation, and vertebrate carcasses were less than 10% of the recommended public exposure maximum permissible concentration (MPC) of the ICRP.

29249 **(IAEA-SM—257/41) Bioaccumulation and distribution of /sup 95m/Tc in an experimental freshwater pond.** Blaylock, B.G.; Frank, M.L. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 27p. (CONF-810722—4). NTIS, PC A03/MF A01. Order Number DE81027118.

From International symposium on migration in the terrestrial environment of long-lived radionuclides from the nuclear fuel cycle; Knoxville, TN, USA (27 Jul 1981).

An acute release of /sup 95m/Tc was made to a small experimental freshwater pond to determine the behavior of technetium in a freshwater ecosystem. The objectives of the study were (1) to determine the distribution of /sup 95m/Tc in the components of the ecosystem and (2) to determine the concentration in freshwater biota. Prior to the release of /sup 95m/Tc, the pond was stocked with aquatic macrophytes, fish, and invertebrates. All components of the pond were sampled for a period of 37 d. Analyses of filtered and unfiltered water samples showed that /sup 95m/Tc did not sorb significantly to particulates suspended in the water but remained dissolved. Sediments accumulated /sup 95m/Tc slowly as the experiment progressed. In the biota, periphyton accumulated / sup 95m/Tc rapidly, reaching the highest concentration (3482 dpm/g dry wt) 4 h after the release and maintaining a relatively high concentration throughout the experiment. Fish and invertebrates accumulated /sup 95m/Tc gradually. Elimination studies and tissue analyses showed that a large percentage of the body burden was in the digestive system of all fish, suggesting that fish were accumulating /sup 95m/Tc through the food chain. Biological halflives determined from elimination studies for carp (Cyprinus carpio), mosquitofish (Gambusia affinis), and snails (Helisoma sp.) were 2.5, 4.3, and 21.3 d, respectively. Calculated concentration factors for the same species were 11 for carp, 75 for mosquito fish, and 121 for snails. The estimated size of the biomass components in the ecosystem in descending order were: periphyton, macrophytes, invertebrates, fish, and algae. Based on biomass estimates and concentrations of the /sup 95m/Tc in the aquatic biota, approximately 1% of the /sup 95m/Tc accumulated in the biota.

29250 **(UCID—19028) Concentrations of radionuclides in reef and lagoon pelagic fish from the Marshall Islands.** Noshkin, V.E.; Eagle, R.J.; Wong, K.M.; Jokela, T.A.; Brunk, J.L.; Marsh, K.V. (California Univ., Berkeley (USA); Lawrence Livermore National Lab., CA (USA)). Jul 1981. Contract W-7405-ENG-48. 65p. NTIS, PC A04/MF A01. Order Number DE81026319.

A radiological survey was conducted from September through November of 1978 to assess the concentrations of persistent man-made radionuclides in the terrestrial and marine environments of 11 atolls and 2 islands of the Northern Marshall Islands. The atolls and islands include Rongelap, Utirik, Taka, Bikar, Rongerik, Ailinginae, Likiep, Jemo, Ailuk, Mejet, Wotho, Ujelang and Bikini. Over 4000 terrestrial and marine samples were collected for radionuclide analysis from 76 different islands. Soils, vegetation, indigenous animals, and cistern and groundwater were collected from the islands. Reef fish, pelagic species, clams, lagoon water, and sediments were obtained from the lagoons. A report is given of all available concentration data for ^{137}Cs, ^{90}Sr, /sup 239+240/Pu, ^{238}Pu, ^{241}Am as well as naturally occurring ^{40}K and other gamma emitting radionuclides in tissues and organs of different species of fish collected from the atolls.

29251 **Model assessment of contaminant seepage from buried uranium mill tailings.** Nelson, R.W.; Reisenauer, A.E.; Gee, G.W. (Battelle, Pac Northwest Lab, Richland, Wash). pp 245-269 of International conference on uranium mine waste disposal, 1st, 1980. Brawner, C.O. (ed.). New York, NY; Soc. of Min. Eng. of the AIME (1980).

From 1. international conference on uranium mine waste disposal; New York, NY, USA (19 May 1980).

Assessment was made to evaluate contaminant transport to ground water from clay-lined and unlined tailings pits. Hydrologic soil characteristics were measured on materials at the Morton Ranch uranium mill in Wyoming. Contaminant flow paths, the advancing contaminant flow fronts for sorbed and non-sorbed constituents, and travel times of contaminants along flow paths enable evaluation of the environmental consequences for alternative control methods. 8 refs.

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 28456, 28458, 28459, 29240

29252 **(ANL/EMR—2Vol.4) Environmental control technology survey of selected US strip mining sites. Volume 4. Evaluation of effluent guidelines for the coal mining industry.** Henning, R.J.; Vocke, R.W. (Argonne National Lab., IL (USA)). Feb 1981. Contract W-31-109-ENG-38. 183p. NTIS, PC A09/MF A01. Order Number DE81027532.

An evaluation is made of the effectiveness of the federal Office of Surface mining coal mine wastewater effluent limitations as they relate to the Surface Mining control and Reclamation Act of 1977 (P.L. 95-87). The act was formulated to protect society and the environment from the adverse effects of surface coal mining operations; it also requires that an adequate coal supply be ensured to meet the nation's energy requirements. To achieve these objectives, an examination of preceding state and federal guidelines is required. At 21 study sites, it was found that compliance with state regulations was generally achieved more often than compliance to the promulgated EPA guidelines. Non-compilance was a result of many hard-to-quantify factors including: dynamic hydrologic conditions, changing mine locations through time, noncontinuous manual treatment strategies, and economic considerations. Changes in the values of water quality variables in the mining environment can be a result of geological and hydrological constraints, as well as inherent random error. This suggests that the promulgation of rigid guideline values that can be exceeded is not the best approach. Rather, statistical methods that recognize sufficiently long recurrence intervals can be used to describe natural conditions more accurately. The variables regulated by the EPA (iron, manganese, total suspended solids, and pH) are not the most toxic commonly present and controllable. Iron and manganese, especially, are present in overburden and are not limiting variables with regard to water quality. Concentrations of toxic trace elements in mine drainage are localized and are related to overburden/coal geochemistry.

29253 **(DOE/EV/03201—T4) Synthetic fuel development for the upper Missouri River basin. Section 13(a). Water assessment report.** (Water Resources Council, Washington, DC (USA)). Apr 1981. Contract AI01-76EV03201. 124p. NTIS, PC A06/MF A01. Order Number DE81025163.

The purpose of the Upper Missouri assessment was to determine the availability of water to support certain hypothetical levels of synfuel development for three types of coal conversion technologies and to identify major effects that synfuel development could have on the water resources of the region. Surface water is generally available in the Upper Missouri River basin to support coal conversion development. Regional availability of groundwater can only be assessed by further field studies. Approximately 700,000 acre-feet of surface water are available annually in the Boysen and Yellowtail Reservoirs on the Brighorn River, pending completion of environmental impact statement and water availability studies by the US Water and Power Resources Service. Not all synfuel development would be located near this water supply, however. Existing single- and multiple-purpose water supply systems in the Upper Missouri would require major modification and expansion to enable the use of water supplies for regional coal conversion development. Possible considerations to provide water at desired plant locations include new storage, interbasin transfers, changes to present water use, and groundwater development. The operations of some reservoirs in the Yellowstone River Basin may need to be altered to assure sufficient flows for energy needs during dry years. The time lag between planning and implementing water supply systems may be 20 years or more. Critical subbasins, such as the Tongue and Powder River, will require further detailed studies to determine what water management alternatives best serve the needs of instream and offstream users. There is a need now for a unified commitment by Federal, State, local and private entities to advance water resources planning management strategies that will ensure that water will be available for energy technology development.

29254 **Summary appraisals of the nation's ground-water resources: Missouri Basin region.** Taylor, O.J. Washington, DC; Government Printing Office (1978). 47p.

The Missouri River and its tributaries furnish water to many users, but surface water is often inadequate to meet large demands. Numerous surface reservoirs help to regulate streamflow and provide storage, but they also allow an increase in evapotranspiration, which in some areas exceeds normal precipitation. Ground water occurs in aquifers classified as alluvial deposits of sand and gravel, glacial deposits, dune-sand deposits, basin-fill deposits of sand and gravel, sandstone, siltstone, fractured sandy clay, limestone, and dolomite. Ground water can be developed and managed in an orderly manner provided adequate geologic and hydrologic data are available to determine aquifer characteristics and response to pumping and other hydraulic stresses. These data and determinations are essential to design, testing, and implementation of water-management plans. Comprehensive water-management planning in the Missouri Basin Region will require periodic or continuing inventory of precipitation, streamflow, surface-water storage, and ground water. Water demands for irrigation, industrial, public supply, and rural use are increasing rapidly. Reliance on ground-water supplies is increasing even though in many areas the ground water is still mostly undeveloped. Optimal use of water supplies will require the establishment of realistic goals and carefully conceived water-management plans, each of which will necessarily be based on an adequate baseline of hydrologic data and knowledge of the highly variable hydrologic systems in the region. 53 references, 12 figures, 8 tables.

5206 Regulations

REFER ALSO TO CITATION(S) 28771, 29217

29255 Paris Convention. Tromp, D. (Paris Commission, London, England). pp 3-18 of Oily water discharges: regulatory, technical and scientific considerations. Johnston, C.S.; Morris, R.J. (eds.). London, England; Applied Science Publishers Ltd. (1980).

From Conference on oily water discharges; Edinburgh, UK (28 Jun 1978).

The main features of the Paris Convention for the Prevention of Marine Pollution from Land-based Sources are described. The contracting parties had undertaken to eliminate pollution by substances appearing in the black list; to limit strictly pollution by other substances on the grey list; and to monitor levels of marine pollution to ascertain the effectiveness of steps taken by contracting parties to deal with pollution by the black and grey list substances. The Convention, signed in 1974, came into effect in 1978 following ratification by seven contracting parties; the first meeting of the commission under the Convention took place in November 1978; and some contracting parties would want to see early agreement on practical measures to implement the Convention which itself calls for urgent action.

29256 Oil and the Paris Convention: the UK view. King, N. (Central Directory for Environmental Pollution, London, England). pp 19-25 of Oily water discharges: regulatory, technical and scientific considerations. Johnston, C.S.; Morris, R.J. (eds.). London, England; Applied Science Publishers Ltd. (1980).

From Conference on oily water discharges; Edinburgh, UK (28 Jun 1978).

Attention is focused on the provisions in the Paris Convention relating to oily water discharges, pointing out that persistent oils and hydrocarbons of petroleum origin were on the black list and non-persistent oils on the grey list. The author referred to the difficulty which the Commission's working group on oil had found in defining persistent oils satisfactorily and that it had, in fact, agreed on a preliminary target standard for oil water discharges from offshore platforms of 40 ppM relating to both persistent and non-persistent oils, thus avoiding the problem of distinguishing between the two. The Commission was currently collecting information on refinery discharges. There might be need to examine the relationship between provisions under the Paris Convention (land-based sources) and those agreements dealing with vessel-source pollution. IMCO's MARPOL-1973 provided for ships generally to discharge oily water to land rather than to sea.

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 28795, 28796, 28797, 28798, 28799, 28800, 28801

5301 Social And Economic Studies

REFER ALSO TO CITATION(S) 28768, 28793, 28794, 28814

29257 (CONF-8104101—) Financing oil-shale communities: strategies for private developers. (Lewin and Associates, Inc., Washington, DC (USA)). 9 Apr 1981. 137p. NTIS, PC A07/MF A01. Order Number DE81026188.

From Seminar on private paths to meeting public needs for oil shale development; Denver, CO, USA (9 Apr 1981).

Efforts are being made which are aimed at helping state and local governments develop plans, develop expertise, and begin preparations for dealing with the emergence of the oil shale industry. These efforts have generated an improved level of understanding of the technical readiness for oil shale technology and the economic fragility of that industry. The purpose of this seminar is to explore and highlight the infrastructure responsibilities and the opportunities for private developers and the skills needed to benefit from these opportunities. A number of experience developers and the skills needed to benefit from these opportunities. A number of experienced developers as well as professional legal and financial experts are participating in this seminar. Speakers' topics include: projected needs for oil shale communities; role and responsibilities for private developers; how to solve the front-end cost problem; and strategies for developers. (DMC)

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 28765, 28767, 28768, 28824, 28917

29258 (RAND/R—2561-DOE) Issues and problems in inferring a level of acceptable risk. Salem, S.L.; Solomon, K.A.; Yesley, M.S. (RAND Corp., Santa Monica, CA (USA)). Aug 1980. Contract AC01-79PE70078. 128p. NTIS, PC A07/MF A01. Order Number DE81026244.

The present study addresses the formulation of risk acceptance criteria and the management of risk by goals. Risk-reduction goals are defined as the minimization of accident probabilities, minimization of maximum accident consequences, reduction of risk to levels as low as reasonably achievable, minimization of socially perceived risks, and the equitable sharing of benefits and risks. The explicit or implicit choice of risk-reduction goals themselves becomes a key to risk regulation. As a consequence, agencies that regulate risk, either directly or indirectly, should explicitly recognize and consider the impacts of the goals they adopt.

5303 Environmental Impact Statements

REFER ALSO TO CITATION(S) 28092, 28093, 28171

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5501 Behavioral Biology

29259 Size-selective predation on zooplankton. Taylor, B.E. Contract AT06-76EV70023. pp 377-387 of Evolution and ecology of zooplankton communities. Kerfoot, W.C. (ed.). Hanover, NH; University Press of New England (1980).

The effects of size-selective predation on Leslie matrix models of the life histories of five zooplankton species were investigated. The results suggest that exponential models, commonly used to analyze zooplankton population dynamics, may not describe adequately the effects of selective predation on zooplankton popula-

tions. These results are a consequence of various age-specific properties of the life histories of the prey populations. The relationships between the effects of selective predation and particular features of the life histories of the zooplankton are also considered.

29260 **Selection of prey by Chaoborus larvae: a review and new evidence for behavioral flexibility.** Pastorok, R.A. Contract AT06-76EV70023. pp 538-554 of Evolution and ecology of zooplankton communities. Kerfoot, W.C. (ed.). Hanover, NH; University Press of New England (1980).

A review of the literature on Chaoborus feeding indicates that the composition of the larval diet, its selective effect on the zooplankton community, and the diel cycle of foraging activity vary between lakes as well as seasonally within a single lake. An examination of the crop contents of fourth instar C. trivittatus in Lake McDonald (Washington State), however, reveals a pattern of size selection that is relatively stable over time. Electrivity values are always positive for medium-sized Daphnia because these prey encounter Chaoborus more frequently than do smaller prey, yet they are more vulnerable to attack and capture than are larger prey. Thus, this aspect of the diet can be explained entirely on the basis of differences in prey availability that are temporally constant. Although Chaoborus is usually regarded as an opportunistic predator, the results of this study show that preferential feeding behavior may outweigh the effects of differences in the vulnerability of prey. Prestarved larvae prefer Diaptomus over Daphnia at high food levels but are nondiscriminatory when food is scarce. Satiated larvae prefer copepods regardless of food concentration. Whereas the functional response of Chaoborus to the density of a single species of prey resembles Holling's type-2 curve, the presence of an alternative food results in an atypical curve for the inferior prey. In this case, the rate of feeding increases with prey density at first, but then reaches a peak and declines with further elevations of food abundance. Thus, spatial and temporal variation in the diet of Chaoborus may be the result of behavioral plasticity exhibited by the predators, differences in the availability of prey, or a combination of both factors.

5502 Biochemistry

REFER ALSO TO CITATION(S) 29246, 29288, 29290, 29291, 29295, 29296, 29297, 29298, 29306, 29311, 29313, 29314, 29315, 29327, 29343, 29346, 29362

29261 **Important hydrodynamic and spectroscopic techniques in the field of chromatin structure.** Olins, D.E. (Univ. of Tennessee, Oak Ridge). Contract W-7405-ENG-26. pp 109-124 of Chromatin structure and function, part A. Nicolini, C.A. (ed.). New York, NY; Plenum Publishing Corporation (1979).

Combining hydrodynamic and spectroscopic techniques in the study of conformational states of ν_1 induced by a variety of perturbants has led us to a general conception: the two structural domains of ν_1 (i.e., the DNA-rich outer shell and the α-helix-rich apolar histone core) exhibit differential responsiveness. In general, the α-helical regions are more resistant, than DNA conformation or ν_1 size and shape, to the perturbing effects of urea, decreased ionic strength and pH, trypsin treatment, or a variety of water-miscible organic solvents. There are a number of reasonable conceptual models to explain this differential responsiveness of the structural domains of ν_1. A few of these models can be denoted with self-descriptive names: e.g., shell-swell, open-clam, or unravelled. Distinction between the various models will require data from many other biophysical techniques, such as neutron scattering studies. Whatever the exact geometry of the transitions, it is tempting to speculate that the α-helical histone core constitutes the restoring force of the nucleosome-returning the conformationally perturbed nucleosome of its inactive compact form.

29262 **Absorption spectrum of DNA for wavelengths greater than 300 nm.** Sutherland, J.C.; Griffin, K.P. (Brookhaven National Lab., Upton, NY). *Radiation Research ;* **86**: No. 3, 399-410(Jun 1981).

Although DNA absorption at wavelengths greater than 300 nm is much weaker than that at shorter wavelengths, this absorption seems to be responsible for much of the biological damage caused by solar radiation of wavelengths less than 320 nm. Accurate measurement of the absorption spectrum of DNA above 300 nm is complicated by turbidity characteristic of concentrated solutions of DNA. We have measured the absorption spectra of DNA from calf thymus, Clostridium perfringens, Escherichia coli, Micrococcus luteus, salmon testis, and human placenta using procedures which separate optical density due to true absorption from that due to turbidity. Above 300 nm, the relative absorption of DNA increases as a function of guanine-cytosine content, presumably because the absorption of guanine is much greater than the absorption of adenine at these wavelengths. This result suggests that the photophysical processes which follow absorption of a long-wavelength photon may, on the average, differ from those induced by shorter-wavelength photons. It may also explain the lower quantum yield for the killing of cells by wavelengths above 300 nm compared to that by shorter wavelengths.

29263 **Poliovirus replication proteins: RNA sequence encoding P3-1b and the sites of proteolytic processing.** Semler, B.L. (State Univ. of New York, Stony Brook); Anderson, C.W.; Kitamura, N.; Rothberg, P.G.; Wishart, W.L.; Wimmer, E. *Proceedings of the National Academy of Sciences of the United States of America ;* **78**: No. 6, 3464-3468(Jun 1981).

A partial amino-terminal amino acid sequence of each of the major proteins encoded by the replicase region of the poliovirus genome has been determined. A comparison of this sequence information with the amino acid sequence predicted from the RNA sequence that has been determined for the 3′ region of the poliovirus genome has allowed us to locate precisely the proteolytic cleavage sites at which the initial polyprotein is processed to create the poliovirus products P3-1b (NCVP1b), P3-2 (NCVP2), P3-4b (NCVP4b), and P3-7c (NCVP7c). For each of these products, as well as for the small genome-linked protein VPg, proteolytic cleavage occurs between a glutamine and a glycine residue to create the amino terminus of each protein. This result suggests that a single proteinase may be responsible for all of these cleavages. The sequence data also allow the precise positioning of the genome-linked protein VPg within the precursor P3-1b just proximal to the amino terminus of polypeptide P3-2.

29264 **Oscillations and control features in glycolysis: analysis of resonance effects.** Termonia, Y.; Ross, J. (Stanford Univ., CA). *Proceedings of the National Academy of Sciences of the United States of America ;* **78**: No. 6, 3563-3566(Jun 1981).

We have presented an analysis of glycolysis based on experimental findings. Here, we give an interpretation based on the concepts of efficiency, resonance response, and control features available to highly nonlinear reaction kinetics. The comprehensive model of glycolysis, for which we presented numerical evaluation of concentration oscillations, entropy production, and average ATP/ADP ratios is separated into two subsystems: one for the phosphofructokinase (PFKase) reaction, the other for the pyruvate kinase (PKase) reaction. We analyze each subsystem separately and find that, for a range of parameter values around the best estimates obtained from experimental data, the PFKase reaction exhibits sustained oscillations. The PKase reaction, on the other hand, is in a stable stationary state and shows an oscillatory relaxation. The period of the PFKase reaction is within 25% of that obtained by computer simulation of the full model. Moreover, if, for a given set of kinetic parameters, the period of the oscillations in the PFKase reaction is of the same order of magnitude as the period of the oscillatory relaxation of the PKase reaction, then the onset of oscillatory behavior past marginal stability forces a tuning of the PFKase reaction period to that of the PKase reaction. Thus, the PKase reaction tunes the frequency of the primary oscillophor, the PFKase reaction, so that a resonance response results in the PKase reaction. We find this result for a substantial range of parameters. The sharp increase in the ATP/ADP ratio and the decrease in the dissipation are seen to be a result of the forced tuning to resonance. The origin of the remarkable control feature of the tuning of one part of the pathway by another that follows in the reaction mechanism is the coupling of the two parts and, in the case of glycolysis, this is realized by the intermediate fructose 1,6-diphosphate, which participates crucially in the PFKase and PKase reactions.

29265 Resistance to acetohydroxamate acquired by slow adaptive increases in urease in cultured tobacco cells. Yamaya, T.; Filner, P. (Michigan State Univ., East Lansing). Contract AC02-76ER01338. *Plant Physiology ;* **67**: No. 6, 1133-1140(Jun 1981).

Urease activity of tobacco XD cells (1U cells) had undergone a 4-fold increase (4U cells) during a year of growth on urea. A clone of 4U cells gave rise to 12U cells during another year of growth on urea. The doubling time of 12U cells on urea is 2.2 days, compared to about 4 days for 1U cells, while 1U and 12U cells double in 2 days on nitrate. Acetohydroxamic acid (AHA), a specific inhibitor/reversible inactivator of jack bean urease, affects tobacco cells urease similarly. Fifty per cent inhibition of growth by AHA occurred at 20 micromolar in 1U cells growing on urea and at 165 micromolar in 12U cells growing on urea, but at 600 micromolar for either 1U or 12U cells growing on nitrate. When 12U cells were grown on urea with 100 micromolar AHA, extractable urease activity decreased 80% within 2.5 hours and remained at this level for 2 weeks; the doubling time increased to 3.7 days, and intracellular urea rosé 2-fold, compared to 12U cells grown on urea without AHA. Urease of 12U cells inactivated by AHA in vivo could be reactivated to its pre-AHA level by incubation at 30 C after extraction and separation from free AHA. AHA inhibited incorporation of ^{15}N from [^{15}N] urea into Kjeldahl nitrogen in the cells, in spite of the increased intracellular urea. These results indicate that AHA acts primarily by inhibiting urease action, rather than by inhibition of formation of urease protein or of uptake of urea. Because 12U cells are 8 times more tolerant of AHA than 1U cells, it is likely that growth on urea in the presence of AHA should select strongly for cells with high urease.

29266 Model of cell activation and desensitization by surface immunoglobin: the case of histamine release from human basophils. Dembo, M.; Goldstein, B. (Los Alamos Scientific Lab., NM). *Cell ;* **22**: 59-67(Nov 1980).

We present a model for the control of immunoglobulin E (IgE)-mediated histamine release from human basophils. We suggest that there is a calcium gating factor which interacts with crosslinked IgE to form a short-lived open calcium channel. After formation of the channel the activated gating factor rapidly decays to an inactive form. It is the loss of the active gating factor which causes the basophil to desensitize nonspecifically. We propose that the crosslinked IgE molecules are deactivated by a mechanism, such as endocytosis or shedding, which is independent of the mechanism which inactivates the calcium gating factor. This loss of functional IgE leads to specific desensitization. The mathematical formulation of the model explains the relationship of specific and nonspecific desensitization to the amount of specific IgE on the basophil surface; explains why there are two types of antigen excess inhibition; explains the relationship between antigen excess inhibition and desensitization; explains why, for a fixed antigen concentration, increasing the concentration of cell surface IgE increases histamine release until an optimal concentration is reached, then decreases histamine release; predicts the effects that changing the external calcium will have on the dose response curve; and predicts that increasing the amount of specific IgE on the cell surface will cause the dose response curve to undergo a transition from a curve with a single maximum to a curve with two maxima.

29267 Interaction of HDL subclasses with phospholipid. Hunter, J.A.; Blanche, P.J.; Forte, T.M.; Nichols, A.V. (Univ. of California, Berkeley). *Annals of the New York Academy of Sciences ;* **348**: 429-430(29 Jun 1980).

As a model system for possible interaction of HDL with surface components released during catabolism of triglyceride-rich lipoproteins, phospholipid uptake by human HDL subclasses, HDL_3 (1.125 to 1.200 g/ml) and HDL/sub 2b/ (1.063 to 1.100 g/m), during in vitro incubation (37°C for 4.5 hours) with increasing amounts of sonicated dispersions of human lipoprotein phosphatidylcholine (HL-PC) are investigated. Possible changes in HDL size and transfer of apolipoproteins are also investigated. In summary, the HDL subclasses, HDL_3, and HDL/sub 2b/, show a capacity for direct uptake of HL-PC. Using HDL compositional data of Anderson, we estimate a maximal uptake of about 32 phospholipid molecules per HDL_3 and 47 per HDL/sub 2b/. Under the conditions used, the size increase associated with HL-PC uptake by HDL_3 was not sufficient in shift it into the HDL/sub 2a/ size range (9.7 to 10.7 nm).

29268 Plasma lipoproteins: historical developments and nomenclature. Lindgren, F.T. (Univ. of California, Berkeley). *Annals of the New York Academy of Sciences ;* **348**: 1-15(29 Jun 1980).

Presented are conclusions in perspective regarding the historical developments of lipoprotein fractionation and their characterization. First, technical problems, inadequate methodology, and misinterpretation of data can long stand in the way of scientific progress. What began as a bizarre distortion of the albumin peak delayed for years utilization of ultracentrifugal techniques for lipoprotein isolation and characterization. However, once solved it seemed simple, and there was a natural flow of developments in all forms of lipoprotein work by incresing numbers of investigators in ever-larger numbers of laboratories, particularly at the National Institutes of Health. These included the important clinical, metabolic, pathologic, and structural aspects of the serum lipoproteins. The present ultracentrifugal characterization involves many more components than were conceived back in 1949 when the first flotation of LDL was observed. This was one important advance in technique.

29269 Histone H2A subfractions and their phosphorylation in cultured Peromyscus cells. Halleck, M.S. (Univ. of New Mexico, Albuquerque); Gurley, L.R. *Experimental Cell Research ;* **125**: 377-388(1980).

Patterns of histone phosphorylation and histone H2A subfractionation have been compared in cultured cell lines from two species of deer mice, Peromyscus eremicus and Peromyscus boylii, which differ considerably in their content of heterochromatin but which contain essentially the same euchromatin content. DNA measurements by flow microfluorometry indicated that P. eremicus cells contained 34.2% more DNA than P. boylii cells, and C-band chromosome analysis indicated that the extra DNA in P. eremicus was present as constitutive heterochromatin. Subfraction of histone H2A by acid-urea polyacrylamide preparative gel electrophoresis in the presence of non-ionic detergent showed that each cell line contained two H2A subfractions. Incorporation of $^{32}PO_4$ into these histones indicated that the steady state phosphorylation of the two H2A subfractions was not the same, the more hydrophobic H2A being greater than two times more phosphorylated than the less hydrophobic H2A in both cell lines. A comparison of the two cell lines indicated that the cell line with 34.2% greater constitutive heterochromatin contained a similar excess (29%) in its ratio of the more highly phosphorylated, more hydrophobic H2A subfraction to the less hydrophobic H2A subfraction. It is suggested that this enrichment of the more highly phosphorylated, more hydrophobic H2A subfraction may be related to the amount of constitutive heterochromatin present in the genome.

29270 Yolk sac endoderm: exclusive site of serum protein synthesis in the early chick embryo. Young, M.F.; Minghetti, P.P.; Klein, N.W. (Univ. of Connecticut, Storrs). Contract EY-76-S-02-3139.A003. *Developmental Biology ;* **75**: 239-245(1980).

In order to determine which cell type or types synthesized serum proteins, yolk sacs from 4-day chick embryos were manually separated into ectoderm, mesoderm, and endoderm and incubated in the presence of radioactive valine. Analysis of the incubation media by polyacrylamide gel electrophoresis as well as by immunoprecipitation showed that all serum proteins were synthesized exclusively by the cells of the endoderm. These included transferrin and three embryo-specific serum proteins: α←globulin α-globulin b, and prealbumin.

29271 Hydroxylamine as a competitive inhibitor for the kinetic enzymatic assay of ethanol in relatively concentrated solutions. Bostick, W.D.; Burtis, C.A. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Biotechnology and Bioengineering ;* **22**: 2437-2439(1980).

The kinetic enzymatic assay of ethanol may be optimized for a selected range of substrate concentrations by a judicious choice of acetaldehyde trapping agent and ADH competitive inhibitor. Hydrazine and hydroxylamine can serve both of these functions. If the

two agents were used simultaneously, hydrazine would serve as the more potent trapping agent and hydroxylamine as the more potent competitive inhibitor.

29272 Effect of H1 on mononucleosome conformation. McCleary, A.R.; Fasman, G.D. (Brandeis Univ., Waltham, MA). *Archives of Biochemistry and Biophysics ;* **201**: No. 2, 603-614(1980).

Mononucleosomes, with an average DNA size of 200 base pairs and a H1,H5 content somewhat below whole nuclei, have been isolated from chicken erythrocyte nuclei. These mononucleosomes have a circular dichroism molar ellipticity, $[\theta]_{283}$, of 4100 deg.cm²/dmol and show a biphasic thermal denaturation profile, with T/sub m(I) = 58°C and T/sub m(II) = 71.5°C. Dissociation of H1 + H5 from the mononucleosomes by 0.6 M NaCl causes $[\theta]_{283}$ to rise to 5200 deg.cm²/dmol and the melting profile to shift to lower temperatures, with T/sub m(I) = 46°C and T/sub m(II) = 68°C. When (H1,H5)-depleted mononucleosomes are reconstituted with H1 to H1/nucleosome mole ratios (r) from 0 to 3.2, several parameters change progressively, reaching endpoints at r = 2: $[\theta]_{283}$ decreased from 5200 to 3300 deg.cm²/dmol, the large melting band at 46°C had disappeared, and the biphasic melting profile become monophasic, with T/sub m/ = 73°C. Further addition of H1 increased the T/sub m/ to 76°C at r = 3.2. The significance of the role of H1 in condensing DNA is discussed.

29273 Direct photometric or fluorometric assay of proteinases using substrates containing 7-amino-4-trifluoromethylcoumarin. Smith, R.E.; Bissell, E.R.; Mitchell, A.R.; Pearson, K.W. (Univ. of California, Livermore). Contract W-7405-ENG-48. *Thrombosis Research ;* **17**: 393-402(1980).

N-Acyl derivatives of 7-amino-4-trifluoromethylcoumarin (I) provide new and novel substrates for the assay of proteinases, allowing either direct fluorometric or photometric measurements. The yellow-green fluorescence of the free coumarin I makes it possible to visually observe hydrolysis of the arylamide bond, thus making it a very useful non-mutagenic fluorophore for the identification and quantification of proteinases whether in dynamic assay or in intact cells.

29274 Neutron diffraction analysis of the structure of rod photoreceptor membranes in intact retinas. Yaeger, M.; Schoenborn, B.; Engelman, D.; Moore, P.; Stryer, L. (Brookhaven National Lab., Upton, NY). *Journal of Molecular Biology ;* **137**: 315-348(1980).

Neutron diffraction data have been collected from samples containing ten dark-adapted Rana catesbiana bullfrog retinas in 100, 80, 60, 40, and 30% D_2O Ringer's solution using a step-scanning Soller slit diffractometer. Diffraction was also recorded from retinas equilibrated in D_2O solutions with varying osmolarity. Rocking curve experiments demonstrated that the rods are disoriented in a cylindrically symmetrical fashion. Structure factor amplitudes were obtained using semi-automated curve-fitting procedures, and phases were obtained by interpreting the D_2O-H_2O and osmotic Patterson maps. In D_2O Ringer's solution the first four structure factors are -353 +- 25, 246 +- 19, 434 +- 13 and 383 +- 19. Neutron scattering density profiles were calculated to 75 A resolution using these structure factors. These neutron diffraction data are consistent with the view that the lipid bilayer is a major structural motif of the rod outer segment disc membrane. Neutron Fourier syntheses in different mixtures of D_2O and H_2O indicate that the intradisc and extradisc spaces are predominantly aqueous, consistent with the increase in the intradisc and extradisc volumes as the Ringer's solution is made more hypotomic. In isotonic Ringer's solution, the thicknesses of the intradisc and extradisc spaces are about 36 A and 160 A, respectively, and the center-to-center separation between the 50 A thick lipid bilayer is 88 A.

29275 Structural and dynamic aspects of drug intercalation into DNA and RNA. Sobell, H.M. (Univ. of Rochester, New York). pp 289-323 of Nucleic acid geometry and dynamics. Sarma, R.H. (ed.). Elmsford, NY; Pergamon Press (1980).

It is now over a decade since Lerman proposed his intercalation hypothesis to explain the strong binding mode of the aminoacridines to DNA. A large body of evidence now supports this concept, and it has become increasingly apparent that - in addition to the aminoacridines - other drugs and dyes bind to DNA by intercalation. The technique of molecular cocrystallization has provided an opportunity to study the detailed structural interactions between many of these drugs with nucleic acid components. These studies have led us to propose unifying structural concepts to understand drug-DNA (and -RNA) interactions. This chapter begins by summarizing the results of our crystallographic studies of drug-nucleic acid crystalline complexes. It then describes detailed models of drug-DNA (and -RNA) interactions suggested by these data. Finally, it presents dynamic concepts of DNA structure that allow one to understand kinetic aspects of drug intercalation - it is possible that these concepts have broader implications to understand protein-DNA interactions.

29276 Mechanism of benzo[a]pyrene diol epoxide induced deoxyribonucleic acid strand scission. Gamper, H.B.; Bartholomew, J.C.; Calvin, M. (Univ. of California, Berkeley). Contract W-7405-ENG-48. *Biochemistry ;* **19**: 3948-3956(1980).

Approximately 1% of (+-) -7β, 8α-dihydroxy-9α,10α-epoxy-7,8,9,10-tetrahydrobenzo[a]pyrene (BaP-diol epoxide) DNA alkylation sites rearrange with strand scission at neutral pH. Phosphotriester hydrolysis and depurination/depyrimidination strand scission were critically examined as possible mechanisms for this phenomenon. No direct evidence was obtained for nicking occurring through phosphotriester hydrolysis. Studies with model substrates, including dibutyl phosphate, DNA homopolymers, and TMV RNA, indicated that if BaP-diol epoxide forms phosphotriesters in DNA or RNA, they do not hydrolyze with strand scission. Besides apurinic/apyrimidinic sites, a second alkali-sensitive rearrangement product was present in BaP-diol epoxide modified DNA. These latter sites accumulated with time and after 24 h accounted for as much as 4% of the initial alkylation events.

29277 Structure of the dihydrofolate reductase inhibitor 2,4,6-triamino-5-chloroquinazoline. Rogan, P.K.; Williams, G.J.B. (Brookhaven National Lab., Upton, NY). *Acta Crystallographica, Section B: Structural Crystallography and Crystal Chemistry ;* **36**: 2358-2362(1980).

Crystals of the title compound, $C_8H_8ClN_5.H_2O$, are monoclinic, C2/c, with a = 29.955 (9), b = 3.853 (1), c = 17.742 (5) A, β = 109.44 (3)°, Z = 8. Intensity data were obtained using Cu Ka radiation on an automatic diffractometer. The structure has been refined by full-matrix least squares against 1736 observed structure factors to yield a final R of 0.064. The molecule is planar with some evidence for a preferred canonical form of the quinazoline system. Partial sp^3 hybridization of two of the three exocyclic amino N atoms permits them to exhibit both donor and acceptor modes in a pair of intermolecular hydrogen bonds.

29278 Use of the dye Hoechst 33258 in a modification of the bromodeoxyuridine photolysis technique for the analysis of DNA repair. Rosenstein, B.S.; Setlow, R.B.; Ahmed, F.E. (Brookhaven National Lab., Upton, NY). *Photochemistry and Photobiology ;* **31**: 215-222(1980).

A modification of the bromodeoxyuridine photolysis technique is described in which the cells are treated with the fluorescent dye Hoechst 33258 to enhance the bromodeoxyuridine photolysis produced by 365 nm or by black light. Use of the modified assay overcomes several difficulties encountered in the original 313 nm photolysis technique and demonstrates that excision repair of damage produced in the DNA by 7,12-dimethylbenz(a)anthracene 5,6-oxide takes place by a long patch type of repair pathway.

29279 Interrelationship of glyocen metabolism and lactose synthesis in mammary epithelial cells of mice. Emerman, J.T.; Bartley, J.C.; Bissell, M.J. (Univ. of California, Berkeley). *Biochemical Journal ;* **192**: 695-702(1980).

Glycogen metabolism in mammary epithelial cells was investigated (i) by studying the conversion of glucose into glycogen and other cellular products in these cells from virgin, pregnant and lactating mice and (ii) by assaying the enzymes directly involved with glycogen metabolism. We find that: (1) mammary epithelial cells synthesized glycogen at rates up to over 60% that of the whole

gland; (2) the rate of this synthesis was modulated greatly during the reproductive cycle, reaching a peak in late pregnancy and decreasing rapidly at parturition, when abundant synthesis of lactose was initiated. We propose that glycogen bynthesis restricts lactose synthesis during late pregnancy by competing successfully for the shared UDP-glucose pool. The physiological advantage of glycogen accumulation during late pregnancy is discussed.

29280 **Influence of uracil photohydrate formation on the conformational properties of heterodinucleoside monophosphates.** Ezra, F.S.; Maccoss, M.; Danyluk, S.S. (Argonne National Lab., IL). *Biopolymers ;* **19**: 1983-2002(1980).

The structural properties of uracil photohydrates at the monomer and dimer level in aqueous solution have been examined in detail by nmr spectroscopy. Based on such evidence, the absolute configurations of the two diastereomers have been assigned, and the conformational perturbations induced by photohydration have been evaluated. In all instances, photohydration shifts the ^{2}E reversible ^{3}E puckering equilibrium of the sugar ring of the uridylyl fragment towards ^{2}E (from 12 to 18%). Significant base-base interactions were observed in both hydrated dimers despite the loss of the planar π-system in the uracil fragment. In addition, the rate of photohydration for a particular dimer pair is shown to be inversely dependent on the amount of base stacking in the parent dimer. This latter parameter has also been correlated with the ratio of the two possible diastereomers formed in the reaction and is associated with a preferential attack at one face of the pyrimidine base ring. The possible biological significance of the above-mentioned conformational aspects is discussed.

29281 **Chemical characterization of a new Japanese variant of carbonic anhydrase I, CA I/sub Nagasaki 1/ (76 Arg → Gln).** Goriki, K.; Tashian, R.E.; Stroup, S.K.; Yu, Y.S.L.; Henriksson, D.M. (Univ. of Michigan, Ann Arbor). Contract E(11-1)-1552. *Biochemical Genetics ;* **17**: No. 5/6, 449-460(1979).

A new inherited variant of carbonic anhydrase I (CA I), designated CA I/sub Nagasaki 1/ (CA I/sub NGS 1/), was discovered during a survey of hemolysates from 5852 individuals from the cities of Hiroshima and Nagasaki in Japan. Analysis of the amino acid composition of a tryptic peptide from the CAI/sub NGS1/ variant indiated that a glutaminyl residue was substituted for an arginyl residue at position 76. Heat degradation studies showed that the CAI/sub NGS 1/ variant was less stable than normal CAI. THe CO_2 hydrase and esterase activities of the normal and variant carbonic anhydrase and esterase activities of the normal and variant carbonic anhydrases I, as well as the rleative amounts of the two enzymes in heterozygotes, were similar.

29282 **Sensitive fluorescent assay for N-acetyltransferase activity in human lymphocytes from newborns and adults.** Meisler, M.H.; Reinke, C. (Univ. of Michigan, Ann Arbor). *Clinica Chimica Acta ;* **96**: 91-96(1979).

We have developed a simplified assay for the enzyme N-acetyltransferase, based upon the loss of fluorescence after acetylation of the substrate p-amino-benzoic acid. This method is sufficiently sensitive to permit the quantitation of N-acetyltransferase activity in 10^5 human lymphocytes. Using this method, we have compared the level of N-acetyltransferase activity in lymphocytes from adult peripheral blood and from cord blood samples.

29283 **Analysis of cellular DNA distributions. II. Analytic solution for G2/G1 peak channel ratios.** Schimmerling, W. (Univ. of California, Berkeley); Todd, P.; Wood, J.C.S. *Cell Biophysics ;* **1**: 355-367(1979).

An analytical formula for calculating peak channel ratios in fluorescent cytophotometric determinations of DNA content per cell was derived to assess the effects of inaccuracies in the model-dependent derivation of S-phase cell populations and of systematic instrumental errors. The DNA distribution histograms usually have two peaks, corresponding to the 2C DNA content of G_1 cells and to the 4C DNA content of G_2 and M cells. In the presence of S-phase cells, the ratio of peak channels G_2/G_1 becomes less than 2. The calculation uses the model-dependent number of S-phase cells per channel and instrumental resolution to obtain G_2/G_1. The peak channel ratio calculated in this way decreases with increasing coefficient of variation and increasing proportion of S-phase cells. The possible experimental effects leading to the observed systematic discrepancy are discussed. A programmable pocket calculator program to perform these calculations is also described in detail.

29284 **Immunochemical analysis of the anthranilate synthase-anthranilate 5-phosphoribosylpyrophosphate phosphoribosyltransferse aggregate of Escherichia coli.** Largen, M.; Mills, S.E. Contract EY-76-S-03-0034. *Biochemistry ;* **16**: No. 11, 2526-2532(1977).

The first two reactions of tryptophan synthesis in Escherichia coli are catalyzed by an aggregate of two proteins each about 60,000 in molecular weight and designated component I (CoI) and component II (CoII). The aggregate formula is $(CoI)_2(CoII)_2$ and the binding is provided by the interaction of component I with a region of component II, the glutamine amidotransferase region, that comprises about one-third of the amino acid chain. We have prepared goat and rabbit antisera to $(CoI)_2(CoII)_2$ in order to examine some of the structural properties of the aggregate as well as the structural relationship between the free and bound forms of the constituent subunits. By means of quantitative microcomplement fixation and precipitation of radiolabeled antigens, evidence was obtained for the following conclusions. The tertiary structure of component I differs little whether it is in the free or bound form. On the other hand, free component II undergoes a notable modification in tertiary structure, displaying extensive heterogeneity. The glutamine amidotransferase region, the linkage region of component II, was found to contribute no antibodies to the several antisera. Since antibodies to this region are made when the unbound component II is injected into rabbits, it appears that the entire surface of the glutamine amidotransferase region is concealed when the aggregate is formed. The immunochemical data thus help to explain properties of the proteins such as the strong, irreversible bond between the aggregate components and, with respect to the components, the relative ease with which component I is purifiable, whereas the purification of component II has not yet been reported.

29285 **Purification by immunoadsorbtion chromatography of the normal and a mutant form of the B_2 subunit of Escherichia coli tryptophan synthase.** Shannon, L.M.; Mills, S.E. (Univ. of California, San Diego, La Jolla). Contract ET(04-3)-34A133. *European Journal of Biochemistry ;* **63**: 563-568(1976).

Columns containing immobilized immunoglobulin G fractions from normal and immunized animals were used to purify the wild-type β component of Escherichia coli tryptophan synthase, formula $\alpha_2\beta_2$, and a mutant form of the β component. The procedure yielded proteins with no detectable contaminants as measured by analytical acrylamide disc gel electrophoresis and immunodiffusion against proteins subject to sodium dodecylsulfate acrylamide electrophoresis. After elution from the antibody column at pH 11 the normal β component, by dialysis against pyridoxal phosphate at pH 7.5, could be restored to the enzymatically-active β_2 dimer with a specific activity of 1700 enzyme units/mg protein. This compares with reported values of 2500 to 3000 enzyme units/mg when the β_2 dimer is purified by conventional means.

5503 Cytology

REFER ALSO TO CITATION(S) 29265, 29266, 29269, 29270, 29298, 29309, 29310, 29311, 29313, 29314

29286 **(DOE/EV/03419—T1) Studies on factors affecting herpesvirus-induced cell fusion. Progress report, July 1, 1978-June 30, 1981.** Person, S. (Pennsylvania State Univ., University Park (USA)). Jun 1981. Contract AS02-76EV03419. 11p. (COO—3419-23). NTIS, PC A02/MF A01. Order Number DE81027224.

Most of our studies over the past thee years have involved a characterization of the fusion process. The timing of some of the molecular events that are required for cell fusion was investigated using agents that block the various synthetic processes. Viral DNA synthesis was not required for cell fusion but fusion did depend on the number of genomes transcribed (up to about 10). RNA synthesis was required until 4 hr after infection, protein synthesis until 5.5

h after infection, and glycosylation of glycoproteins until 7 h after infection.

29287 **(DOE/EV/03419—T2) Studies on factors affecting herpesvirus-induced cell fusion. Progress report, July 1, 1980-June 30, 1981.** Person, S. (Pennsylvania State Univ., University Park (USA)). Jun 1981. Contract AS02-76EV03419. 8p. (COO—3419-22). NTIS, PC A02/MF A01. Order Number DE81027230.

The difference in the fusion sensitivity of HEL and HEp-2 cells was shown not to be due to receptors for fusion factor on the surfaces of the infected cells. Fusion inhibition of syn mutant-infected cells by nonsyncytial-infected cells was shown to require the synthesis of virus glycoproteins up to about 6 h after infection. The DNA sequences required for virus entry have been identified. Cell fractionation studies have revealed a slower accumulation of fully glycosylated glycoproteins in the smooth membranes of syncytial-infected cells relative to those of nonsyncytial-infected cells.

29288 **(DOE/EV/03941—62) Mechanisms of recombination and function of DNA in bacteria. Progress report, August 16, 1980-June 20, 1981.** Guild, W.R. (Duke Univ., Durham, NC (USA). Dept. of Biochemistry). 1981. Contract AS05-76EV03941. 14p. NTIS, PC A02/MF A01. Order Number DE81027218.

Two lines of work have been pursued intensively and have yielded significant progress in this period. These are: (1) the analysis of the pathway of plasmid transformation in pneumococcus and the use of this work to begin studies on cloning in a pneumococcus host-vector system, and (2) further study of the novel kind of gene transfer, formally like conjugation, that was found to be exhibited by drug resistance elements present in the chromosomes of some clinical isolates of pneumococcus.

29289 **Image intensification applied to light microscopy.** Reynolds, G.T.; Taylor, D.L. (Princeton Univ., NJ). Contract EY-76-S-02-3120. *Bioscience ;* **30**: No. 9, 586-592(Sep 1980).

Although this paper is concerned primarily with the application of image intensification to light microscopy, much of the quantitative evaluation of the intensifier-TV detector system has been derived from applications to x-ray diffraction. The technique converts x-rays to visible light by means of a suitable scintillator. This light is fiber optically coupled to the image intensifier cathode, and intensification is achieved in the usual way. The method is useful where (1) the specimen is weakly diffracting, (2) the x-ray intensity must be kept low or exposure times short in order not to damage the specimen, or (3) dynamic structure studies are involved.

29290 **Kinetics of proliferation and differentiation of human hemopoietic cells in a diffusion chamber system.** Chikkappa, G.; Carsten, A.L.; Cronkite, E.P. (Brookhaven National Lab., Upton, NY). Contract EY-76-C-02-0016. *Experimental Hematology (Copenhagen) ;* **8**: No. 5, 533-540(May 1980).

Proliferation and differentiation of human granulocytes were studied in a diffusion chamber (DC) culture system. Evaluation of the nucleated marrow cells of normal volunteers revealed that the granulocytic precursors continue differentiation in the DC as they do in vivo. Generation time of the granulocytes in the multiplicative pool in DC was determined by the autoradiographic mean grain count halving method. With trititated thymidine (^{3}HTdR) the half-time was 67 h, whereas with ^{125}Iododeoxyuridine it was 47 h. The longer half-time with ^{3}HTdR supports the notion that a fraction of nuclear ^{3}HTdR from dead cells is reutilized by the newly proliferating cells. The ^{3}HTdR labeling index of granulocytic precursors in the multiplicative pool during the first 10 days in DC is not constant, suggesting a variation in the rate of proliferation. The DNA synthesis time in DC, determined by double isotope labeling technique, showed that it was relatively constant. Simultaneous evaluation of rate of transition of granulocytes in DC from one stage to the next of one patient with chronic myelocytic leukemia and another with myeloid metaplasia with myelofibrosis indicated a more rapid transition in the DC than in vivo in man.

29291 **Role of magnesium in neutrophil production and function.** Brennan, J.K.; Seelig, C.B.; Lichtman, M.A. pp 169-183 of Magnesium in health and disease. Jamaica, NY; Spectrum Publications, Inc. (1980).

We have reviewed the effects of e.c. Mg on neutrophil production, adhesion, movement, and phagocytosis in vitro. Some consideration has also been given to the effects of Ca, since this ion often interacts with Mg. Both Mg and Ca are required for optimal proliferation of circulating presumptive granulocyte precursor cells. Used alone, Mg and Ca are equipotent; together they produce a greater than additive effect. In the absence of Mg and Ca, proliferation is virtually abolished. Magnesium is preeminent in adhesion and aggregation; Ca will neither substitute for, nor augment the effect of Mg. Although cell movement is relatively resistant to divalent cation deprivation, Mg and Ca are required for optimal neutrophil movement, especially chemotaxis. Magnesium is more potent than Ca, but optimal concentrations of either produce the same maximal stimulation of chemotaxis. When used together, the ions have an additive effect. The requirements of Mg and Ca for optimal phagocytosis of microorganisms have not been defined. Magnesium and Ca are required for optimal ingestion of emulsified paraffin oil droplets. Magnesium is more potent than Ca, in that it supports ingestion at lower concentrations and stimulates greater maximal ingestion. Magnesium could exert its effects on neutrophil properties, in part, through interactions with plasma complement, cyclic nucleotidases, and contractile elements.

29292 **(DOE/EV/03335—T1) Molecular events basic to cellular radiation response.** Kolodny, G.M. (Massachusetts General Hospital, Boston (USA). Radiology Research Lab.; Beth Israel Hospital, Boston, MA (USA). Div. of Nuclear Medicine). [nd]. Contract AS02-76EV03335. 23p. (COO—3335-28). NTIS, PC A02/MF A01. Order Number DE81027898.

The initiation and control of the division process in normal cells is studied to gain insight into changes in these regards caused by x-irradiation and neoplasia. The Primer Hypothesis for eukaryotic gene regulation proposes that small molecular weight RNA acts as primer for new RNA synthesis by hybridizing with DNA and there initiating the transcription of a new RNA chain. The experiments reported here indicate that small molecular weight RNA will induce the production of new proteins. These results are consistent with the Primer Hypothesis, and demonstrate that RNA can be taken up from the media by cells in culture and can induce in vitro the production of differentiated cell products. (ACR)

5504 Genetics

REFER ALSO TO CITATION(S) 29247, 29263, 29272, 29275, 29281, 29286, 29287, 29288, 29306

29293 **(BNL—29730) Comparison of plasmid transformation and the cloning of recombinant DNA in Streptococcus pneumoniae and Bacillus subtilis.** Lopez, P.; Stassi, D.L.; Espinosa, M.; Lacks, S.A. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 19p. (CONF-810694—2). NTIS, PC A02/MF A01. Order Number DE81027422.

From 25. Wind River conference on genetic exchange; Estes Park, CO, USA (8 Jun 1981).

The molecular cloning of the malM gene of Streptococcus pneumoniae in a strain of S. pneumoniae bearing a deletion of the chromosomal mal region enabled us to investigate the feasibility of recombinant DNA cloning also in the presence of chromosomal homology. Encouraged by the information so obtained, we then inserted chromosomal fragments into pLS1, a miniplasmid derivative of the pMV158 vector used for the mal cloning, in its single EcoRI restriction site. In this manner the sul-d gene responsible for sulonamide resistance was cloned. The availability of the mal recombinant plasmid also allowed a comparison between plasmid transfer, that is the establishment of a new plasmid, the plasmid transformation, that is the alteration of a homologous endogenous plasmid, in S. pneumoniae. These findings were related to published work by others on plasmid transfer and transformation in S. pneumoniae and Bacillus subtilis. In both species the results are consistent with a mode of DNA entry in which single strand fragments of donor DNA are

introduced into the cell. Models for the subsequent reconstruction of plasmid and recombinant DNA are presented.

29294 **(DOE/EV/03941—61) Nonrandom cotransformation by related plasmids in streptococcus pheumoniae.** Saunders, C.W.; Hageman, J.; Guild, W.R. (Duke Univ., Durham, NC (USA). Dept. of Biochemistry). 1981. Contract AS05-76EV03941. 10p. NTIS, PC A02/MF A01. Order Number DE81026512.

Gene cloning in gram positive bacterial systems is of increasing interest and it would be helpful to know how plasmid DNA transforms recipient cells. A highly nonrandom cotransformation by related plasmids that is readily explainable and may be expected to show up frequently in other systems has been found. Control experiments with unrelated plasmids were significant in showing that essentially all the cells were competent for plasmid transformation. (ACR)

29295 **Relationship of DNA lesions and their repair to chromosomal aberration production.** Bender, M.A. (Brookhaven National Lab., Upton, NY). pp 245-265 of DNA repair and mutagenesis in eukaryotes. Generoso, W.M.; Shelby, M.D.; deSerres, F.J. (eds.). New York, NY; Plenum Publishing Corporation (1980).

Though the roles of some specific DNA lesions in the production of chromosomal aberrations is clearly established, those of others remain unclear. While the study of aberration production in human genetic DNA repair deficiency diseases has been extremely rewarding already, eukaryotic repair systems are obviously complex, and one is tempted to feel that such studies may have raised as many questions as they have provided answers. It seems certain that further study of chromosomal aberration production in repair deficient cells by agents inducing various DNA lesions will reveal even greater complexity in eukaryotic DNA repair systems and their role in chromosomal aberration production. Nevertheless, there seems hope, at least, that such studies may also ultimately lead to a complete understanding of the molecular mechanisms involved.

29296 **DNA repair pathways.** Setlow, R.B. (Brookhaven National Lab., Upton, NY). pp 45-54 of DNA repair and mutagenesis in eukaryotes. Generoso, W.M.; Shelby, M.D.; deSerres, F.J. (eds.). New York, NY; Plenum Publishing Corporation (1980).

Our knowledge about DNA repair mechanisms in mammalian cells is reviewed. Ways of measuring excision repair are summarized, and various modes of excision repair are described in terms of mechanisms that yield patch sizes of 0, 1, a few (short patch), and many (long patch) bases. The biological and molecular ways of measuring the effects of replication on a damaged template are presented, as are various models of postreplication repair.

29297 **Contribution of genes controlling total serum cholesterol to prediction of cardiovascular disease risk in the general population.** Sing, C.F.; Orr, J.D.; Moll, P.P. (Univ. of Michigan, Ann Arbor). pp 587-618 of Genetic analysis of common diseases: applications to predictive factors in coronary disease. New York, NY; Alan R. Liss, Inc. (1979).

It is generally accepted that coronary heart, cerebral vascular and peripheral vascular diseases aggregate in families. There is little agreement, however, about the extent to which this aggregation is due to shared genes. It is our belief that statistical analyses using appropriate samples of observational data can have great utility in determining the extent to which the variability of genotypes and environments in the human population are associated with the observed pattern of disease among individuals within and between families. This report focuses on a review of the role research on total serum cholesterol has played in understanding the association between genetic variability and disease variability in the general population.

5505 Metabolism

REFER ALSO TO CITATION(S) 29264

29298 **Electron probe X-ray microanalysis and the cellular basis of transepithelial calcium transport.** Coleman, J.R. (Univ. of Rochester, NY). pp 509-515 of Microbeam analysis in biology. Lechene, C.P.; Warner, R.R. New York, NY; Academic Press (1979).

Calcium is essential to many vital processes including such diverse phenomena as muscle contraction, nerve conduction, and hormone response, as well as bone and tooth formation. Because of the wide spectrum of calcium effects, it is generally agreed that the concentration of free calcium within the cytoplasmic space is low and relatively constant. In fact, in the few situations where it has been possible to measure cytoplasmic calcium activity, values of 10^{-7} M or less were reported, and increases in this value led to changes in cell activity. This observation has raised a crucial question about epithelial cells, which transport calcium from one surface to another: How can the calcium pass through these cells without altering the cytoplasmic calcium concentrations in a way that could disrupt normal metabolism. In order to examine this question, we have investigated two quite different calcium transporting epithelial: the mucosal layer of the rat and chick small intestine, and the ectodermal layer of the embryonic chick chorioallantoic membrane. Briefly, the calcium transporting mechanisms in both of these epithelia can be studied in vitro using conventional methods with radioactive tracers and such studies have shown that both tissues transport calcium against a concentration gradient, using an energy-dependent mechanism that has a requirement for sodium. Electron probe x-ray microanalysis was used to examine the cellular aspects of this transport process to learn which parts of the calcium-transporting cells increased their calcium concentration.

5506 Medicine

REFER ALSO TO CITATION(S) 29107, 29297, 29310, 29317, 29562

29299 **(BNL—29737) Use of nuclear resonant scattering of gamma rays for in vivo measurement of iron.** Vartsky, D.; Wielopolski, L.; Ellis, K.J.; Cohn, S.H. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 20p. (CONF-810647—8). NTIS, PC A02/MF A01. Order Number DE81026051.

From Conference on X- and gamma-ray sources and applications; Ann Arbor, MI, USA (10 Jun 1981).

A technique for determination of elements in human body in-vivo, utilizing nuclear resonant scattering of gamma rays has been developed. 847 keV photons emitted from a gaseous $^{56}MnCl_2$ source are resonantly scattered from ^{56}Fe present in the body. The detection of these gamma rays is used to estimate the iron content of the liver or heart of patients. Details of the calibration procedure and potential molecular effects are described.

29300 **(BNL—29783) Neutron dosimetry in boron neutron capture therapy.** Fairchild, R.G.; Miola, U.J.; Ettinger, K.V. (Brookhaven National Lab., Upton, NY (USA); Aberdeen Univ. (UK)). 1981. Contract AC02-76CH00016. 18p. (CONF-810673—3). NTIS, PC A02/MF A01. Order Number DE81027649.

From 4. symposium on neutron dosimetry; Munich-Neuherberg, F.R. Germany (1 Jun 1981).

The recent development of various borated compounds and the utilization of one of these ($Na_2B_{12}H_{11}SH$) to treat brain tumors in clinical studies in Japan has renewed interest in neutron capture therapy. In these procedures thermal neutrons interact with ^{10}B in boron containing cells through the $^{10}B(n,\alpha)^7Li$ reaction producing charged particles with a maximum range of approx. 10μm in tissue. Borated analogs of chlorpromazine, porphyrin, thiouracil and deoxyuridine promise improved tumor uptake and blood clearance. The therapy beam from the Medical Research Reactor in Brookhaven contains neutrons from a modified and filtered fission spectrum and dosimetric consequences of the use of the above mentioned compounds in conjunction with thermal and epithermal fluxes are dis-

cussed in the paper. One of the important problems of radiation dosimetry in capture therapy is determination of the flux profile and, hence, the dose profile in the brain. This has been achieved by constructing a brain phantom made of TE plastic. The lyoluminescence technique provides a convenient way of monitoring the neutron flux distributions; the detectors for this purpose utilize ^{6}Li and ^{10}B compounds. Such compounds have been synthesized specially for the purpose of dosimetry of thermal and epithermal beams. In addition, standard lyoluminescent phosphors, like glutamine, could be used to determine the collisional component of the dose as well as the contribution of the $^{14}N(n,p)^{14}C$ reaction. Measurements of thermal flux were compared with calculations and with measurements done with activation foils.

29301 **(DOE/EV/03333—T1) New imaging systems in nuclear medicine. Progress report, June 1, 1979-May 31, 1980.** Brownell, G.L. (Massachusetts General Hospital, Boston (USA)). 1981. Contract AS02-76EV03333. 47p. (COO—333-30). NTIS, PC A03/MF A01. Order Number DE81025969.

Basic objectives remain for incorporation of time-of-flight in a multiring system of a positron tomographic system. (PSB)

29302 **(DOE/EV/04078—T2) Interactive radiopharmaceutical facility between Yale Medical Center and Brookhaven National Laboratory. Progress report, September 1980-April 1981.** Gottschalk, A. (Yale Univ., New Haven, CT (USA). Dept. of Diagnostic Radiology). 1981. Contract AS02-76EV04078. 24p. NTIS, PC A02/MF A01. Order Number DE81027858.

Progress made in the past eight months is reported for the following research areas: (1) the evaluation of ^{11}C labeled acid-ester analogue of arachidonic acid (AA) as a potential agent for the studies of cardiac pathophysiology; and (2) the evaluation of new radioactive agents for improving methods of radiolabeling cellular blood elements. (ACR)

29303 **(SAND—81-0840C) Implantable insulin delivery system.** Love, J.T.; Gaona, J.I. Jr. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 4p. (CONF-810904—1). NTIS, PC A02/MF A01.

From 3. annual conference of the IEEE Engineering in Medicine and Biology Society; Houston, TX, USA (19 Sep 1981).

An insulin delivery system suitable for experimental implants and external use has been developed to study glucose control for diabetics. The programmable system developed at Sandia National Laboratories, in conjunction with the University of New Mexico School of Medicine, employs miniature electronics and mechanical technologies developed for use in other Department of Energy programs.

29304 **(UCLA—12/1296) Signal Amplification Technique (SAT): an approach for improving resolution and reducing image noise in computed tomography.** Phelps, M.E.; Huang, S.C.; Hoffman, E.J.; Plummer, D.; Carson, R. (California Univ., Berkeley (USA); California Univ., Los Angeles (USA)). 1981. Contract AC03-76SF00012. 58p. NTIS, PC A04/MF A01. Order Number DE81025818.

Spatial resolution improvements in computed tomography (CT) have been limited by the large and unique error propagation properties of this technique. The desire to provide maximum image resolution has resulted in the use of reconstruction filter functions designed to produce tomographic images with resolution as close as possible to the intrinsic detector resolution. Thus, many CT systems produce images with excessive noise with the system resolution determined by the detector resolution rather than the reconstruction algorithm. CT is a rigorous mathematical technique which applies an increasing amplification to increasing spatial frequencies in the measured data. This mathematical approach to spatial frequency amplification cannot distinguish between signal and noise and therefore both are amplified equally. We report here a method in which tomographic resolution is improved by using very small detectors to selectively amplify the signal and not noise. Thus, this approach is referred to as the signal amplification technique (SAT). SAT can provide dramatic improvements in image resolution without increases in statistical noise or dose because increases in the cutoff frequency of the reconstruction algorithm are not required to improve image resolution. Alternatively, in cases where image counts are low, such as in rapid dynamic or receptor studies, statistical noise can be reduced by lowering the cutoff frequency while still maintaining the best possible image resolution. A possible system design for a positron CT system with SAT is described.

29305 **Boundary method for attenuation correction in positron computed tomography.** Huang, S.C.; Carson, R.E.; Phelps, M.E.; Hoffman, E.J.; Schelbert, H.R.; Kuhl, D.E. (Univ. of California, Los Angeles). Contract AM03-76-SF-0012. *Journal of Nuclear Medicine ;* **22**: No. 7, 627-637(Jul 1981).

A new method for attenuation correction in positron computed tomography (PCT) has been developed, and it can improve the quality of PCT images. The method requires a short transmission scan by the PCT system. Then boundaries between tissues with significantly different attenuation coefficients are determined from the transmission image by edge-finding techniques. Attenuation correction factors (ACF) are then calculated using these boundaries and the average attenuation coefficients within the enclosed regions. The method has been tested on computer-simulated data, on scans of phantoms, and on patient studies, and has been found effective in reducing the random noise in transmission measurements and in providing more accurate ACFs than the method using geometric attenuation correction. As a result, transmission scan times can be shortened, inconvenience to patients is reduced, and PCT images are improved.

5507 Microbiology

REFER ALSO TO CITATION(S) 29263

29306 **(DOE/ER/10680—1) Study of the genetics and regulation of methane oxidation. Progress report, first year, August 1, 1980-July 31, 1981.** (Washington Univ., Seattle (USA)). 1981. Contract AT06-80ER10680. 5p. NTIS, PC A02/MF A01. Order Number DE81025505.

The plasmids present in M. ethanolicum have been characterized as to size, relatedness, and curing rate. Auxotrophs have been isolated and are being tested for the ability of several plasmids to promote mobilization of these markers. A cloning vector has been identified which can be used not only to clone the genes of interest but to isolate mutants in these genes and place a selectable marker on each of the plasmids. Isolation of a series of methane and methanol mutants, determination of which of the plasmids carries the mtn gene(s), and identification of methane-specific proteins on two-dimensonal O'Farrell gels should all be completed shortly. In addition, the cloning of the methane genes and development of a genetic system should be well underway. A more detailed appraisal of future experiments is presented in the accompanying renewal proposal. (ERB)

29307 **Separation of heavy metals from aqueous solutions using biosorbents: development of contacting devices for uranium removal.** Shumate, S.E. II; Strandberg, G.W.; McWhirter, D.A.; Parrott, J.R. Jr.; Bogacki, G.M.; Locke, B.R. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Biotechnology and Bioengineering Symposium ;* No. 10, 27-34(1980).

The specific objective of the work described herein was to evaluate the utility of a mixed culture of denitrifying bacteria for the separation of uranium from process wastewaters. The selection of this culture was based upon the knowledge that wastewaters generated in a number of nuclear-materials processing operations require treatment to remove both nitrate and uranium. It was anticipated that microbial cells, resulting as a by-product in the conversion of nitrate to gaseous molecular nitrogen, might serve as an effective biosorbent for the separation of uranium from the wastewaters. The culture was evaluated with respect to the rate of uranium accumulation and the equilibrium distribution of uranium between the cell and solvent phases. The effects of process variables on the rate of uranium accumulation and equilibrium distribution were studied. Several methods for contacting the biosorbent

with aqueous uranium solutions were examined. These included suspended cells or flocs in stirred-tank reactors and films of cells or inert particles in columnar reactors.

29308 **Frequency-dependent selection for plasmid-containing cells of Escherichia coli.** Adams, J.; Kinney, T.; Thompson, S.; Rubin, L.; Helling, R.B. (Univ. of Michigan, Ann Arbor). Contract EY-77-C-02-2828. *Genetics ;* **91**: 627-637(Apr 1979).

Colicin-producing plasmid-containing cells of E. coli exhibit frequency-dependent selection when grown in glucose-limited continuous culture with the corresponding plasmid-free strain. The bases of this frequency-dependent effect are shown to be (1) the lower growth rate of the plasmid-containing strain under these conditions; and (2) the production of colicin, which attenuates the growth rate of the plasmid-free strain. These results are discussed in relationship to the maintenance of genetic variation in prokaryotes.

5508 Morphology

29309 **Gap junctions of chick lens fiber cells.** Kuszak, J.; Maisel, H.; Harding, C.V. (Wayne State Univ., Detroit, MI). Contract EY-76-S-02-2401. *Experimental Eye Research ;* **27**: 495-498(1978).

Gap junctions of chick lens cortical fiber cells are extensive in distribution and can be visualized by scanning electron microscopy.

29310 **Scanning electronmicroscopy of the human corneal endothelium in primary graft failure.** Cowden, J.W.; Harding, C.V. (Wayne State Univ., Detroit, MI). Contract EY-76-S-02-2401. pp 1671-1674 of XXIII concilium ophthalmologicum. Shimizu, K.; Oosterhuis, J.A. (ed.). Amsterdam, Netherlands; Excerpta Medica (1978).

Human corneal primary graft failures examined by SEM show evidence of highly specific cellular changes. These changes are a result of inadequate endothelium which may arise from several causes including diseased or damaged donor tissue (Fuch's endothelial dystrophy, excessive storage time, cryopreservation), complicated surgical technique (IOL insertion, poor alignment of inner layer), and recipient factors such as badly diseased endothelium. These cellular changes may be related to the cause of the primary graft failure.

5509 Pathology

REFER ALSO TO CITATION(S) 29302

29311 **Asialoglycoprotein receptor mediates the toxic effects of an asialofetuin-diphtheria toxin fragment A conjugate on cultured rat hepatocytes.** Cawley, D.B.; Simpson, D.L.; Herschman, H.R. (Univ. of California, Los Angeles). Contract AM03-76SF00012. *Proceedings of the National Academy of Sciences of the United States of America ;* **78**: No. 6, 3383-3387(Jun 1981).

We have constructed a toxic hybrid protein that is recognized by asialoglycoprotein (ASGP) receptors of cultured rat hepatocytes. The conjugate consists of fragment A of diphtheria toxin (DTA) linked by a disulfide bond to asialofetuin (ASF). This conjugate is highly toxic, inhibiting protein synthesis in primary rat hepatocytes at concentrations as low as 10 pM. The ASF-DTA conjugate was 600 and 1800 times as toxic as diphtheria toxin and DTA, respectively, on primary rat hepatocytes. The ASGP receptor recognizes galactose-terminated proteins. We tested a series of glycoproteins for their ability to block the action of the ASF-DTA conjugate. Fetuin and orosomucoid, two glycoproteins with terminal sialic acid on their oligosaccharide chains, did not block the action of the conjugate. Their galactose-terminated asialo derivatives, ASF and asialoorosomucoid, as expected, did block the action of the conjugate. The N-acetylglucosaminyl-terminated derivative (asialoagalactoorosomucoid) had no appreciable effect on the activity of the conjugate. We tested the ASF-DTA conjugate on six cell types; except for primary rat hepatocytes, none of them were affected by a high concentration (10 nM) of ASF-DTA conjugate. A fetuin-DTA conjugate was less toxic by a factor of 300 than the ASF-DTA conjugate and exerted its effects primarily through non-receptor-mediated mechanisms. The highly toxic ASF-DTA conjugate is cell-type specific, and its action is mediated by a well-characterized receptor, whose mechanism of receptor-ligand internalization has been extensively investigated.

5510 Physiological Systems

REFER ALSO TO CITATION(S) 29270, 29274, 29341, 29342

29312 **Utilization of solar radiation by polar animals: an optical model for pelts; an alternative explanation.** Bohren, C.F.; Sardie, J.M. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Applied Optics ;* **20**: No. 11, 1894-1896(1 Jun 1981).

An optical model for the pelt of a polar bear is presented that accounts for ultraviolet light and other optical properties that the bear's pelt has been known to exhibit. (AIP)

29313 **Electrical potentials in stomatal complexes.** Saftner, R.A.; Raschke, K. (Michigan State Univ., East Lansing). Contract AC02-76ER01338. *Plant Physiology ;* **67**: No. 6, 1124-1132(Jun 1981).

Guard cells of several species, but predominantly Commelina communis, were impaled by micropipette electrodes and potential differences measured that occurred between cell compartments and the flowing bathing medium. The wall developed a Donnan potential that was between -60 and -70 millivolt in 30 millimolar KCl at pH 7. The density of the fixed charges ranged from 0.3 to 0.5 molar; its dependence on pH was almost identical with the titration curve of authentic polygalacturonic acid. The vacuolar potential of guard cells of Commelina communis L., Zea mays L., Nicotiana glauca Graham, Allium cepa L., and Vicia faba L. was between -40 and -50 millivolt in 30 millimolar KCl when stomata were open and about -30 millivolt when stomata were closed. The vacuolar potential of guard cells of C. communis was almost linearly related to stomatal aperture and responded to changes in the ionic strength in the bathing medium in a Nernstian manner. No specificity for any alkali ion (except Li^+), ammonium, or choline appeared. Lithium caused hyperpolarization. Calcium in concentrations between 1 and 100 millimolar in the medium led to stomatal closure, also caused hyperpolarization, and triggered transient oscillations in the intracellular potential. Gradients in the electrical potential existed across stomatal complexes with open pores. When stomata closed, these gradients almost disappeared or slightly reverted; all epidermal cells were then at potentials near -30 millivolt in 30 millimolar KCl.

29314 **Immune responses in pulmonary lymph of sheep after intrabronchial administration of heterologous erythrocytes.** Joel, D.D.; Chanana, A.D.; Chandra, P. (Brookhaven National Lab., Upton, NY). Contract AC02-76CH00016. *American Review of Respiratory Diseases ;* **122**: 925-932(1980).

The response of the lower respiratory tract to intrabronchial administration of horse red blood cells (HRBC) was studied in sheep by continuous monitoring of efferent lymph issuing from the regional caudal mediastinal lymph node. The immune response was assessed by enumerating direct and indirect plaque-forming cells (PFC) in pulmonary lymph, bronchoalveolar lavage, and blood as a function of time after immunization. Within 3 days, PFC began to appear in pulmonary lymph, reaching a peak between Days 5 and 7. During the primary immune response, PFC were not detected in either bronchoalveolar lavage or blood. A second antigenic challenge resulted in a rapid, marked increase in lymph PFC, predominantly of the indirect type. Plaque-forming cells in lung lavage and blood, although observed after a secondary challenge, were inconsistent, particularly with the lower dosages of antigen. Within the narrow range of antigen dosage used, there was a clear dose-response relationship for a lymph-borne PFC during both the primary and secondary immune response. As with PFC, a high titer of antibody in lymph preceded its appearance in serum. The results indicated that monitoring efferent lung lymph can be a very sensitive and reproducible method to assess various aspects of pulmonary immune responses. In contrast, bronchoalveolar lavage elements did not effectively reflect the status of immune reactivity in the lower respiratory tract.

29315 **Bone material and calcification mechanisms.** Neuman, W.F. pp 83-107 of Fundamental and clinical bone physiology. Urist, M.R. (ed.). Philadelphia, PA; J. B. Lippincott Company (1980).

Presented is a comprehensive review of skeletal physiology and skeletal calcification mechanisms. Discussed in detail are topics of the state of calcium and phosphate in body fluids, the mineral phase of hard tissues, the location of opatitic crystals in cartilage and bone, mechanisms of calcification, and the mineralization processes in bone and cartilage.

5520 Public Health

REFER ALSO TO CITATION(S) 29281, 29336

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 28311

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 28325, 29107, 29144, 29222, 29222, 29222, 29250, 29262, 29292, 29348, 29348

29316 **(BNL—29631) Role of base damage in aberration formation: interaction of aphidicolin and x-rays.** Bender, M.A.; Preston, R.J. (Brookhaven National Lab., Upton, NY (USA); Oak Ridge National Lab., TN (USA)). 1981. Contract AC02-76CH00016. 21p. (CONF-810494—1). NTIS, PC A02/MF A01. Order Number DE81025065.

From Conference on DNA-repair chromosome alterations and chromatin structure; Noordwijkerhout, Netherlands (23 Apr 1981).

The base analog cytosine arabinoside (CA) is an inhibitor of DNA synthesis that is able to induce chromosomal aberrations not only in the DNA synthetic (S) phase of the cell cycle but in cells in the pre- (G_0 or G_1) and in the post-DNA-synthetic (G_2) phases of the cell cycle as well. Incubation of human peripheral lymphocytes in CA following either G_0 or G_2 x irradiation causes a synergistic increase in chromosomal aberration frequency. CA is believed to preferentially inhibit DNA polymerase α. It is suggested that it is inhibition of the repair of x-ray-induced base damage that is responsible for the synergistic effect on chromosomal aberration production observed with x-ray and CA treatment of human peripheral lymphocytes. It has also been observed that CA induces sister chromatid exchanges (SCE) in mammalian cells when present during normal DNA replication and that it also interacts synergistically with uv in the induction of SCE. A number of other inhibitors of DNA synthesis were also tested, one, aphidicolin (APC), did produce effects similar to CA at the same concentration. Aphidicolin is a tetracyclic diterpinoid that inhibits the growth of eukaryotic cells by inhibition of DNA synthesis. This action has been shown to result from specific inhibition of DNA polymerase α, but not of polymerases β or γ. Unlike CA, it seems likely that APC inhibits by binding to and inactivating the DNA-α polymerase complex. Because both CA and APC are α polymerase inhibitors and because both interact synergistically with uv in the production of SCE, studies were conducted to determine whether APC also shares other cytogenetic properties of CA. Results to date have shown that, like CA, APC is clastogenic in both G_0 and G_2, and it also interacts synergistically with x rays to increase chromosomal aberration production in both G_0 and G_2. (ERB)

29317 **(BNL—29670) Non-invasive nuclear detection of choroidal melanoma.** Packer, S.; Lambrecht, R.M.; Fairchild, R.G.; Wolf, A.P.; Atkins, H.L.; Fand, I. (Brookhaven National Lab., Upton, NY (USA); Cornell Univ., New York (USA). Medical Coll.; State Univ. of New York, Stony Brook (USA). Dept. of Psychiatry and Behavioral Science). 1981. Contract AC02-76CH00016. 15p. (CONF-810595—1). NTIS, PC A02/MF A01. Order Number DE81025075.

From International symposium on intraocular tumors; Schwerin, German Democratic Republic (17 May 1981).

The biodistribution of over 30 radiopharmaceuticals thought to be tumor-seeking agents were studied using hamsters and mice. Several radiopharmaceuticals were found to be appropriate as melanoma localizing agents. Results with modified dual pinhole collimator and a pigment affinic agent (iodine-123 labeled quinoline) and a non-specific tumor seeking agent (gallium-67 citrate) are also reported.

29318 **(CONF-800392—(Vol.1)) Proceedings of the public meeting to address a proposed federal radiation research agenda. Volume I. Issue papers.** (Interagency Radiation Research Committee, Washington, DC (USA)). Mar 1980. 443p. NTIS, PC A19/MF A01. Order Number DE81025070.

From Public meeting on federal research into biological effects of ionizing radiation; Bethesda, MD, USA (10 Mar 1980).

Separate abstracts were prepared for 11 of the 12 invited issue papers and for 3 of the 13 documents received from the public at large in the preparation of an agenda for federally sponsored and conducted research into the biological effects of ionizing radiation. One issue paper previously input to the data base deals with the potential for significant human exposure from environmentally dispersed radionuclides.

29319 **(CONF-800392—(Vol.2)) Proceedings of the public meeting to address a proposed federal radiation research agenda. Volume 2. Science projection papers.** (Interagency Radiation Research Committee, Washington, DC (USA)). Mar 1980. 503p. NTIS, PC A22/MF A01. Order Number DE81025071.

From Public meeting on federal research into biological effects of ionizing radiation; Bethesda, MD, USA (10 Mar 1980).

Separate abstracts were prepared for the 14 science projection papers presented at a public meeting on March 10-11, 1980 to address a proposed federal radiation research agenda into the biological effects of ionizing radiation.

29320 **(CONF-810673—1) Review of dosimetry for the atomic bomb survivors.** Kerr, G.D. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 18p. NTIS, PC A02/MF A01. Order Number DE81023225.

From 4. symposium on neutron dosimetry; Munich-Neuherberg, F.R. Germany (1 Jun 1981).

This paper summarizes and discusses results of some 1980-1981 studies of neutron and γ-ray exposure to the atomic bomb survivors by W.E. Loewe and E. Mendelsohn of the Lawrence Livermore National Laboratory, D.C. Kaul and W.H. Scott of Science Applications, Inc., and J.V. Pace of the Oak Ridge National Laboratory. Some other special studies which are now underway to complete the review will also be discussed. The expert assistance of others in these special studies is being supported in part by the US Department of Energy and in part by the US Defense Nuclear Agency.

29321 **(CONF-810694—1) Psoralen-plus-light damage and repair in transforming DNA of Bacillus subtilis.** Hadden, C.T. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Oak Ridge (USA). Graduate School of Biomedical Sciences). 1981. Contract W-7405-ENG-26. 14p. NTIS, PC A02/MF A01. Order Number DE81024140.

From 25. Wind River conference on genetic exchange; Estes Park, CO, USA (8 Jun 1981).

The relative contributions of excision and recombination in the repair of damage by 8-methoxypsoralen (8-MOP) plus black light to Bacillus subtilis were studied. The results indicate that the pyrimidine dimer excision system and a recombination pathway are probably both involved in repair of lethal damage to cells exposed in vivo to 8-MOP plus black light, but repair is not very efficient. Transforming DNA exposed in vitro to 8-MOP plus black light was inactivated mainly by crosslinks rather than by monoadducts, and was repaired predominantly by an incision-dependent process. There was very little demonstrable damage-induced recombination in transforming DNA.

29322 (DOE/EV/03382—19) Radioactivity studies progress report. Cohen, N. (New York Univ., NY (USA). Medical Center). 30 Jun 1980. Contract AS02-76EV03382. 265p. (COO—3382-19). NTIS, PC A12/MF A01. Order Number DE81027461.

This research describes the metabolism of ^{243,244}Cm in nine adult female baboons following exposure by intravenous injection. Curium-243, 244 was administered to each baboon as a single injection of curium citrate in 0.08 M citric acid - sodium citrate buffer solution at pH 3.5 in dosage ranging from 0.053 to 0.220 μCi/kg. The behavior of ^{243,244}Cm at these low experimental dosage levels has been quantitated by various methods including external in vivo whole body and partial body counting, bioassay of blood, urine and feces samples, liver biopsies, and post-mortem tissue analysis. The structure and parameters of a model illustrating the interaction of seven internal compartments with respect to the translocation kinetics of ^{243,244}Cm was derived based upon the above data. Solutions of the model represented as groups of exponential expressions have been derived for two specific time-related exposures. Finally, investigation of the efficacy of diethylene-triaminepentaacetic acid (DTPA) to remove ^{243,244}Cm from the body was tested.

29323 (INIS-mf—5843) Collection of abstracts of conference papers. (Eoetvoes Lorand Fizikai Tarsulat, Budapest (Hungary)). 1980. 47p. (CONF-8003112—(Absts.)). NTIS (US Sales Only), PC A03/MF A01.

From Advanced radiation protection training course; Tihany, Hungary (19 Mar 1980).

Individual papers are included in the data base. (PSB)

29324 (ORNL—5519) Emergency protection from aerosols. Cristy, G.A.; Chester, C.V. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 50p. NTIS, PC A03/MF A01. Order Number DE81027067.

Expedient methods were developed that could be used by an average person, using only materials readily available, to protect himself and his family from injury by toxic (e.g., radioactive) aerosols. The most effective means of protection was the use of a household vacuum cleaner to maintain a small positive pressure on a closed house during passage of the aerosol cloud. Protection factors of 800 and above were achieved.

29325 (PNL—3716) Lung-clearance classification of ^{241}Am and $^{238-240}$Pu in dust collected near the sites of Hanford Incidents 2827 and 2828. Kalkwarf, D.R.; Thomas, C.W. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1981. Contract AC06-76RL01830. 14p. NTIS, PC A02/MF A01. Order Number DE81028258.

Dust samples containing ^{241}Am and $^{238-240}$Pu were obtained from sites near the occurrences of Hanford Incidents 2827 and 2828, and the alpha-activity ratios of ^{241}Am/$^{239-240}$Pu were found to be 215 and 1.7, respectively. The latter sample was also found to have a ^{238}Pu/$^{239-240}$Pu alpha-activity ratio of 0.033. The dissolution rates of these radionuclides into simulated lung fluid at 37°C were measured over a period of 10 days, and these measurements were used to classify the samples in terms of the lung clearance model proposed by the International Commission on Radiological Protection. The results showed that less than 0.02% of the $^{239-240}$Pu in both samples and less than 0.02% of the ^{238}Pu in the sample from Incident 2828 had dissolved in 10 days. Only 0.01% of the ^{241}Am in the sample from Incident 2827 and 0.27% of the ^{241}Am in the sample from Incident 2828 dissolved during this time period. It is recommended that the ^{241}Am and $^{239-240}$Pu components in both of these samples be considered 100% Y-type compounds for calculations with the ICRP Lung Clearance Model.

29326 (JPRS—78577) East Europe report: scientific affairs, No. 709. (Joint Publications Research Service, Arlington, VA (USA)). 22 Jul 1981. Translation of various articles. 51p. NTIS. Order Number DE81903564.

This collection of translations includes papers on studies of radiation effects following nuclear explosions. (ACR)

29327 Free radicals in pyrimidines: ESR of γ-irradiated 5-cyclohexenyl-1,5-dimethyl barbituric acid. Benson, B. (Lehigh Univ., Bethlehem, PA); Erich, L. Contract EY-77-S-02-2367. *Radiation Research ;* **86**: No. 3, 411-418(Jun 1981).

ESR studies have determined that ionizing radiation damage of hexobarbital (5-cyclohexenyl-1,5-dimethylbarbituric acid) causes the formation of a free radical (A) by hydrogen abstraction from the cyclohexenyl group. Hyperfine coupling tensors were determined for coupling of the unpaired electron to four protons. Visible light of wavelengths near 450 nm reversibly converts this radical to a second free radical (B) which also has the unpaired electron localized in the cyclohexenyl group. The activation energy for a thermally induced reverse conversion (B → A) was determined to be 1.4 eV.

29328 Effect of γ-irradiated DNA on the activity of DNA polymerase. Leadon, S.A.; Ward, J.F. (Univ. of California, Los Angeles). *Radiation Research ;* **86**: No. 3, 445-458(Jun 1981).

A cell-free assay was developed to measure the effect of γ-irradiated DNA template on the ability of DNA polymerase to copy unirradiated template. Doses as low as 1 krad were able to decrease (~ 15%) the activity of both bacterial and mammalian DNA polymerases in the assay. The percentage of polymerase activity decreased as the dose received by the template increased. The reduction in DNA polymerase activity was shown to be due to an inhibition of the enzyme by the irradiated DNA. Irradiated poly(dA-dT) was more effective in reducing polymerase activity than calf thymus DNA. Thus the polymerase-inhibition site(s) appears to be associated with base damage, specifically adenine or thymine. Using a free-radical scavenger, OH radicals were found to be involved in producing the damage sites. The interaction between irradiated DNA and DNA polymerase was found to be specific for the enzyme and not for other proteins present in the assay. The inhibition of DNA polymerase occurred prior to or during the initiation of DNA synthesis rather than after initiation of synthesis, i.e., during elongation.

29329 Lifetime studies of ^{226}Ra and ^{90}Sr toxicity in beagles. A status report. Raabe, O.G.; Book, S.A.; Parks, N.J.; Chrisp, C.E.; Goldman, M. (Univ. of California, Davis). Contract AM03-76SF00472. *Radiation Research ;* **86**: No. 3, 515-528(Jun 1981).

Beagles at the University of California at Davis injected with ^{226}Ra of fed ^{90}Sr have been under lifetime study for over 18 years. This report summarizes the dose-response observations to June 30, 1978. Bone marrow dyscrasias were more numerous than bone cancers from ^{90}Sr at dose rates to bone of about 2 to 20 rad/day, while bone cancers have been the dominating effect of ^{226}Ra at dose rates of from 0.5 to about 20 rad/day. No radiogenic effects are yet apparent for skeletal doses below 0.5 rad/day. Results to date indicate that although bone cancer continues to be the important endpoint for ^{226}Ra, other cancer types appear to be more important for ^{90}Sr (such as soft-tissue cancers adjacent to bone), particularly at late times from lower skeletal dose rates.

29330 Biological effects of accelerated heavy ions. I. Single dose in normal tissue, tumors, and cells in vitro. Goldstein, L.S.; Phillips, T.L.; Fu, K.K.; Ross, G.Y.; Kane, L.J. (Univ. of California, San Francisco). Contract AM0S-16SF01012. *Radiation Research ;* **86**: No. 3, 529-541(Jun 1981).

To characterize beams of possible use in radiotherapy, the survival of jejunal crypt cells, EMT 6 tumor cells in flank tumors, and hypoxic and euoxic EMT 6 tumor cells in vitro was studied following irradiation in beams of accelerated helium, carbon, neon, or argon ions. The beams were modified with a variable-thickness absorber to give a 4-cm spread out Bragg peak (SOBP) and therefore approximated the kind of beam geometry anticipated for the clinical application of high-LET beams. The RBE was higher in cells in the EMT 6 tumor than in the gut, and higher for hypoxic cells than for euoxic cells. The RBE increased with increasing LET up to aproximately 100 keV/μm. The RBE was higher for the peak region than for the plateau region of the helium, carbon, and neon beams leading to a favorable biological depth-dose distribution

measured as the peak-to-plateau RBE ratio. The argon beam had an unfavorable peak-to-plateau RBE ratio.

29331 Biological effects of accelerated heavy ions. II. Fractionated irradiation of intestinal crypt cells. Goldstein, L.S.; Phillips, T.L.; Ross, G.Y. (Univ. of California, San Francisco). Contract AM0S-16SF01012. *Radiation Research ;* **86**: No. 3, 542-558(Jun 1981).

The survival of jejunal crypt cells was measured following irradiation in 1, 2, 5, or 10 fractions in beams of accelerated helium, carbon, neon, or argon ions. The beams were modulated to spread the Bragg peak in order to approximate the geometry anticipated in clinical applications. There was less recovery in cells irradiated in the peak regions than in the plateau regions for all the beams. For neon with a 4-cm spread out Bragg peak (SOBP) and for argon with a 10-cm SOBP, fractionated irradiation was more effective than single-dose irradiation. Multifraction irradiation in high-LET beams enhanced the peak-to-plateau relative biological effectiveness ratio compared to single-fraction irradiation, and therefore fractionation inproved the biological depth-dose distribution of charged-particle beams.

29332 Life shortening in mice exposed to fission neutrons and γ rays. I. Single and short-term fractionated exposures. Thomson, J.F.; Williamson, F.S.; Grahn, D.; Ainsworth, E.J. (Argonne National Lab., IL). Contract W-31-109-ENG-38. *Radiation Research ;* **86**: No. 3, 559-572(Jun 1981).

Quantitative dose-response relationships are presented for life shortening in mice from all causes of death after irradiation with 0.85-MeV fission neutrons or ^{60}Co γ rays, delivered either in a single exposure (neutrons, 20 to 240 rad; γ rays, 90 to 788 rad) or in 24 weekly fractions (total doses: neutrons, 20 to 320 rad; γ rays, 206 to 5110 rad). The effectiveness of a given dose of γ rays was decreased when the dose was fractionated; however, the effectiveness of a given dose of neutrons was significantly increased. For both single and fractionated exposures, the relative biological effectiveness (RBE) of neutrons varied inversely with the square root of the neutron dose over the range of doses studied. Depending on the method of calculation, the coefficient of the RBE-dose relationship (the RBE at 1 neutron rad) for single exposures was predicted to be 28 or 33 for males and 40 or 44 for females. For fractionated exposures, the extrapolated values were 62 or 91 for males and 41 or 79 for females.

29333 Life shortening in mice exposed to fission neutrons and γ rays. II. Duration-of-life and long-term fractionated exposures. Thomson, J.F.; Williamson, F.S.; Grahn, D.; Ainsworth, E.J. (Argonne National Lab., IL). Contract W-31-109-ENG-38. *Radiation Research ;* **86**: No. 3, 573-579(Jun 1981).

Data are presented on the life shortening of B6CF$_1$ mice given weekly exposures to 0.85-MeV fission neutrons (0.67, 1.67, 2.67 rad per weekly fraction) or ^{60}Co γ rays (7, 17.4, 31.9 rad per weekly fraction) either for 60 exposures or for the duration of their lives. The life shortening produced by either the duration-of-life or the fractionated exposures was virtually identical, so the two series were treated as a single experiment. The relative biological effectiveness (RBE) for neutrons increased from 12 at 2.67 rad per weekly fraction to 21 at 0.67 rad per weekly fraction; over the dose ranges studied, the neutron RBE varied inversely with the -0.4 power of the dose. It is predicted that at 0.05 rad of neutrons per week, the RBE will approach 60 if weekly exposures to γ radiation are chosen as the reference; if continuous γ radiation is used as the reference, the RBE may be approximately twice as large.

29334 Repair of DNA double-strand breaks in Escherichia coli cells requires synthesis of proteins that can be induced by UV light. Krasin, F.; Hutchinson, F. (Yale Univ., New Haven, CT). Contract AC02-76EV03571. *Proceedings of the National Academy of Sciences of the United States of America ;* **78**: No. 6, 3450-3453(Jun 1981).

The repair of DNA double-strand breaks in Escherichia coli cells irradiated with γ rays occurs only after new proteins are synthesized in response to damage introduced in the genome DNA. One protein whose synthesis is thus induced is the recA protein, and previous work has shown that recA$^-$ cells do not repair double-strand breaks. However, inducing recA protein by treating cells with nalidixic acid does not induce repair of double-strand breaks, so this repair requires more than the presence of the recA protein. When repair of double-strand breaks is blocked, the genome DNA is degraded by an endonuclease-like action. Evidence is presented to show that the inducible inhibition of DNA degradation after x-irradiation [Pollard, E.C. & Randall, E.P. (1973) Radiat. Res. 55, 265] is probably caused by the inducible repair of DNA double-strand breaks.

29335 Genetic diversity of UV-sensitive DNA repair mutants of Chinese hamster ovary cells. Thompson, L.H. (Lawrence Livermore National Lab., CA); Busch, D.B.; Brookman, K.; Mooney, C.L.; Glaser, D.A. Contract W-7405-ENG-48. *Proceedings of the National Academy of Sciences of the United States of America ;* **78**: No. 6, 3734-3737(Jun 1981).

Mutant lines of Chinese hamster ovary cells that show hypersensitivity to killing and mutagenesis by uv light were analyzed by genetic complementation analysis to determine whether defects in different gene loci might underlie a common cellular phenotype. To facilitate rapid screening of mutant clones, a procedure was devised that allowed presumptive complementation to be assessed on the basis of the frequency of uv-resistant cells after fusion by polyethylene glycol. Four classes were identified among 44 clones tested. By using drug-resistance markers for selection of hybrid cells in crosses between uv mutant and wild type, a mutant from each of the four classes was shown to behave as phenotypically recessive. Hybrids were also isolated from crosses between each of the pair combinations of the four mutants. All such hybrids were relatively resistant to uv killing, providing confirmation of the complementation classes. When mutants representing the four uv-complementation classes were tested with the polyaromatic hydrocarbon 7-bromomethylbenz(a)anthracene, complementation was again seen for all pair combinations. These results suggest that each class of mutants represents a biochemical defect that plays a common role in the repair of both uv-induced and chemically induced lesions in the DNA.

29336 State-vector model for life shortening in mice after brief exposures to low doses of ionizing radiation. Scott, B.R.; Ainsworth, E.J. (Argonne National Lab., IL). *Mathematical Biosciences ;* **49**: 185-205(1980).

A model for radiation-induced life shortening caused by late effects is presented. The model is based on the concept that life shortening from late effects is caused mainly by tumors induced by the radiation. The model is kinetic in nature and describes a two-step process that leads to the bipartition of the irradiated population into two groups: (1) those with and (2) those without radiation-induced tumors which cause life shortening. For group (1) it is assumed that the mean survival time is relatively independent of the absorbed radiation dose. For group (2) it is assumed that the mean survival time will be nearly identical to that of an unirradiated control population. Results based on the model are shown to be consistent with presently available data including curvilinear dose-response relationships after single-dose exposure to 300-kVp x-rays, 1-MeV neutrons, or 60-MeV protons; an enhancement in dose effect after fractionated exposure to fission neutrons; and a dose-sparing effect after fractionated exposure to ^{60}Co gamma rays.

29337 UV-light-induced mutations in synchronous CHO cells. Burki, H.J. (Lawrence Berkely Lab., CA); Lam, C.K.; Wood, R.D. Contract W-7405-ENG-48. *Mutation Research ;* **69**: 347-356(1980).

Asynchronous and synchronous CHO cells were irradiated with germicidal UV light to determine the fluence response curve for cell killing, and the induction of resistance to 6-thioguanine, ouabain, and diphtheria toxin. For asynchronous populations the data show a sigmoidal response for induced reproductive death, as has been seen by others, with a D_0 of 6 J/m^2 and an extrapolation number of 2.5. The induction of mutations appears to be a linear function for all three mutagenic markers up to a dose of 17 J/m^2. Reproductive death induced in the synchronous populations is a function of the time at which exposure occurs in the cell cycle, with late G_1 and early S being the sensitive stages. The induction of resistance to 6TG, ouabain, and diphtheria toxin (DT) all seem

to depend on the time of exposure in the cell cycle. As in the case of UV-induced reproductive death, the more sensitive periods for mutation induction appear also to be the G_1 and early S period of the cell cycle, with the largest cyclic variation occurring for induced DT resistance. A comparison of the results reported here for the UV exposure with exposures of synchronous CHO cells to x-rays and ethylnitrosourea suggests that there are different age-specific responses to mutation induction for each agent, and that there are often different age responses for different mutagenic endpoints with the same mutagen.

29338 **Imprecision of dose predictions for radionuclides released to the environment: an application of a Monte Carlo simulation technique.** Schwarz, G.; Hoffman, F.O. (Oak Ridge National Lab., TN). *Environment International ;* **4**: No. 4, 289-297(1980).

An evaluation of the imprecision in dose predictions has been performed using current dose assessment models and present knowledge of the variability or uncertainty in model parameter values. The propagation of parameter uncertainties is demonstrated using a Monte Carlo technique for elemental ^{131}I transported via the pasture-cow-milk-child pathway. The results indicate that when site-specific information is not available the imprecision inherent in the predictions for this pathway is potentially large. Generally, the 99th percentile in thyroid dose for children was predicted to be approximately an order of magnitude greater than the median value. The potential consequences of the imprecision in dose for radiation protection purposes are discussed.

29339 **DNA excision in repair proficient and deficient human cells treated with a combination of ultraviolet radiation and acridine mustard (ICR-170) or 4-nitroquinoline 1-oxide.** Ahmed, F.E.; Setlow, R.B. (Brookhaven National Lab., Upton, NY). *Chemico-Biological Interactions ;* **29**: 31-42(1980).

Excision repair was measured in normal human and xeroderma pigmentosum group C fibroblasts treated with ultraviolet radiation and the carcinogens acridine mustard (ICR-170) or 4-nitroquinoline 1-oxide (4NQO) by the techniques of unscheduled synthesis, photolysis of bromodeoxyuridine incorporated into parental DNA during repair, and assays of sites sensitive to ultraviolet (uv)-endonuclease. Doses of ICR-170 and 4NQO, low enough not to inhibit unscheduled DNA synthesis (UDS), caused damage to DNA that was repaired by a long patch type mechanism. Repair after a combined action of uv plus ICR-170 or uv plus 4NQO was additive in normal cells. In xeroderma pigmentosum (XP) C cells there was less repair after uv plus ICR-170 than after each treatment separately; whereas there was an additive effect after uv plus 4NQO and no inhibition of loss of endonuclease sensitive sites. The results indicate that in normal human fibroblasts there are different rate limiting steps for removal of chemical and physical damages from DNA and that XP cells have a different repair system for ICR-170, not just a lower level, than normal cells.

29340 **Plasmid mediated enhancement of uv resistance in Streptococcus faecalis.** Miehl, R.; Miller, M.; Yasbin, R.E. (Pennsylvania State Univ., University Park). *Plasmid ;* **3**: 128-134(1980).

A 38.5-Mdal plasmid of Streptococcus faecalis subdp. zymogenes has been shown to enhance survival following uv irradiation. In addition, the presence of this plasmid increases the mutation frequencies following uv irradiation and enhanced W-reactivation. The data presented indicate that S. faecalis has an inducible error-prone repair system and that the plasmid enhances these repair functions.

29341 **Effect of thymectomy and splenectomy on the course of x-ray induced progressive intercapillary glomerulosclerosis in the mouse kidney.** Guttman, P.H. (Univ. of California, San Francisco). Contract AT(11-1)-34. *International Archives of Allergy and Applied Immunology ;* **31**: 163-173(1967).

Whole body neonatal irradiation (450 rads) of Swiss-Webster mice resulted in progressive intercapillary glomerulosclerosis (IGS). Neonatal thymectomy potentiated the effect of irradiation. Removal of the spleen at 18 days markedly reduced the effect of irradiation on the kidney when combined with thymectomy at birth. In the presence of an intact thymus, splenectomy had no effect on the course of radiation induced IGS. Germinal center formation and plasma cell infiltration were observed in the thymus of splenectomized-irradiated mice. The possible role of immunity in the pathogenesis of late effects of x-ray on the kidney is considered in the light of these findings.

29342 **Presence of γG and β1C globulins in renal glomeruli of aging and neonatally x-irradiated mice.** Guttman, P.H.; Wuepper, K.D.; Fudenberg, H.H. Contract AT(11-1)-34. *Vox Sanguinis ;* **12**: 329-339(1967).

A renal lesion in rodents, termed progressive intercapillary glomerulosclerosis (IGS), is characterized by gradual increase in the thickness of the mesangium due to cell proliferation, clustering, and pleomorphism of the mesangial cells, accumulation of PAS-positive mesangial matrix and progressive increase in the thickness of capillary basement membranes. Electron microscopy reveals deposits of electron-dense material in kidneys with IGS suggestive of plasma proteins in the mesangial matrix and in the basement membranes. IGS appears early in life and progresses with age. Whole body irradiation or direct irradiation of the kidneys causes acceleration of the glomerular lesion. A latent period precedes the onset of demonstrable histologic changes following x-ray; this latent period is of shorter duration in animals irradiated late in life. In previous studies, the possible role of an immune mechanism in the pathogenesis of IGS was suggested by the following observations: (1) the progressive course of the disease after a latent period following a single exposure to x-ray; (2) the similarity of the lesions to those seen in experimental immune disease of the kidney in rodents; (3) the presence of electron-dense material suggesting plasma protein deposits in the basement membranes and matrix; and (4) the potentiating effect of neonatal thymectomy on the course of radiation-induced IGS.

5602 Thermal Effects

29343 **Heat shock proteins of higher plants.** Key, J.L. (Univ. of Georgia, Athens); Lin, C.Y.; Chen, Y.M. Contract A509-80ER10678. *Proceedings of the National Academy of Sciences of the United States of America ;* **78**: No. 6, 3526-3530(Jun 1981).

The pattern of protein synthesis changes rapidly and dramatically when the growth temperature of soybean seedling tissue is increased from 28°C (normal) to about 40°C (heat shock). The synthesis of normal proteins is greatly decreased and a new set of proteins, heat shock proteins, is induced. The heat shock proteins of soybean consist of 10 new bands on one-dimensional $NaDodSO_4$ gels; a more complex pattern is observed on two-dimensional gels. When the tissue is returned to 28°C after 4 h at 40°C, there is progressive decline in the synthesis of heat shock proteins and reappearance of a normal pattern of synthesis by 3 or 4 h. In vitro translation of poly(A)$^+$ RNAs isolated from tissues grown at 28 and 40°C shows that the heat shock proteins are translated from a new set of mRNAs induced at 40°C; furthermore, the abundant class mRNAs for many of the normal proteins persist even though they are translated weakly in vivo at 40 or 42.5°C. The heat shock response in soybean appears similar to the much-studied heat shock phenomenon in Drosophila.

5603 Chemicals Metabolism And Toxicity

REFER ALSO TO CITATION(S) 28164, 28221, 28771, 29107, 29339

29344 **(BNL—51318) Inhalation chamber technology.** Drew, R.T. (ed.). (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract AC02-76CH00016. 109p. (CONF-7810255—). NTIS, PC A06/MF A01. Order Number DE81023861.

From Inhalation chamber technology conference; Upton, NY, USA (16 Oct 1978).

Separate abstracts were prepared for 2 of the 13 chapters of this book which consists of the edited proceedings of a meeting held in October 1978 to discuss inhalation chamber technology. The chapters not abstracted discuss new developments and experiments in inhalation chamber design. (KRM)

29345 (BNL—51318, pp 21-30) **Cones, cone angles, plenums, and manifolds.** Carpenter, R.L.; Beethe, R.L. (Lovelace Inhalation Toxicology Research Inst., Albuquerque, NM). 1978. NTIS, PC A06/MF A01.

From Inhalation chamber technology conference; Upton, NY, USA (16 Oct 1978).

At the Inhalation Toxicology Research Institute a need to expand the traditional nose-only animal exposure capability to include whole-body exposure capabilities for chronic exposure was identified. In the course of developing these facilities, we identified several requirements for acceptable exposure chamber criteria. The criteria established required: (1) nonrotational uniform flow from chamber inlet to outlet, i.e., plug flow; (2) no aerosol recirculation from below the animals to the area above the animals; (3) uniform aerosol distribution with respect to both size distribution and concentration. Additional constraints limited our initial considerations to the tangential-feed, pyramid-shaped inlet- and exhaust- 27-in chambers, often called Hinners chambers. We began with the study of the airflow characteristics within the chambers and concluded that modifications could be made to produce an airflow pattern which more nearly corresponded to the desired flow characteristics. Chamber airflow patterns were determined by injecting TiO_2-HCl smoke into the chamber through a probe and noting the direction of flow from the probe.

29346 (CONF-810489—1) **Deformation of DNA by carcinogenic agents.** Broyde, S.; Hingerty, B.; Stellman, S. (Oak Ridge National Lab., TN (USA); New York Univ., NY (USA). Dept. of Biology; American Cancer Society, New York. Dept. of Epidemiology and Statistics). 1981. Contract W-7405-ENG-26. 36p. NTIS, PC A03/MF A01. Order Number DE81023187.

From 2. SUNYA conversation in molecular stereodynamics; Albany, NY, USA (26 Apr 1981).

The nature of the conformational alteration imposed by the carcinogenic agents and the origin of the base specificity was studied by computation of classical potential energies as a function of conformation. Van der Waals, electrostatic, torsional and deoxyribose strain contributions to the energy were computed. Where appropriate, the energy is minimized with all rotations that are sources of conformational variability, including the deoxyribose pucker, flexible.

29347 (CONF-810491—1) **Altered tissue reactivity and interactions between chemicals.** Witschi, H.P. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 33p. NTIS, PC A03/MF A01. Order Number DE81023189.

From NRC workshop on multichemical contamination; Milan, Italy (27 Apr 1981).

Interactions between chemicals may modify the biological response if exposure is simulatneous or sequential. Two different situations can be distinguished where interactions are caused by sequential exposure: (1) a first agent acts as an inducer or inhibitor of mixed function oxidases. This alters the response to a second, challenging agent. The nature of the biological response, whether enhanced or abolished, is dictated by the second agent; and (2) a first agent produces slight or possibly undetected or undetectable changes in a tissue. Exposure to a second agent enhances or allows expression of the biological response determined by the first agent. Both types of interactions are characterized by a requirement for a strictly ordered sequence of exposure to two chemicals and by complex dose-effect and time-effect relationships. Detection of such interactions is not likely to occur if exposure is simultaneous or unless specific experimental questions dealing with the nature and modification of the biological response are explored.

29348 (DOE/EV/03571—21) **Biological effects of DNA repair, including mutagenesis. Progress report, June 15, 1980-May 1, 1981.** Hutchinson, F. (Yale Univ., New Haven, CT (USA)). 1981. Contract AS02-76EV03571. 11p. (COO—3571-21). NTIS, PC A02/MF A01. Order Number DE81024434.

A mutagen of interest is used to create mutations in the cI gene of lambda phage, producing a clear plaque phenotype. Genetic mapping is used to determine which restriction fragment in the gene contains the mutation. The fragment is then isolated and sequenced by the Maxam-Gilbert technique. Thus, the actual changes in base sequence produced by the action of the mutagen may be determined and also the base sequence surrounding the mutation. Such studies will be useful in understanding the mechanisms by which a mutation occurs, since any proposed mechanism must be consistent with the observations. The results also give information on the specificity of mutagens.

29349 (DOE/EV/04267—4) **Health effects of combustion-generated soot and polycyclic aromatic hydrocarbons. Progress report, May 1, 1980-April 30, 1981.** Thilly, W.G. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nutrition and Food Science). May 1981. Contract AS02-77EV04267. 54p. NTIS, PC A04/MF A01. Order Number DE81025651.

Major progress has been made during 1980 in the development and conception of more useful human cell assays for genetic damage, in the identification of the major contributors to mutation of human cells by combustion effluents and in extending the use of the systems previously developed to the study of the mechanisms of chemical mutation of human cells.

29350 (DOE/EV/04964—3) **Inducible error-prone repair in B. subtilis. Final report, September 1, 1979-June 30, 1981.** Yasbin, R.E. (Pennsylvania State Univ., University Park (USA)). Jun 1981. Contract AS02-78EV04964. 15p. (COO—4964-3). NTIS, PC A02/MF A01. Order Number DE81027897.

The research performed under this contract has been concentrated on the relationship between inducible DNA repair systems, mutagenesis and the competent state in the gram positive bacterium Bacillus subtilis. The following results have been obtained from this research: (1) competent Bacillus subtilis cells have been developed into a sensitive tester system for carcinogens; (2) competent B. subtilis cells have an efficient excision-repair system, however, this system will not function on bacteriophage DNA taken into the cell via the process of transfection; (3) DNA polymerase III is essential in the mechanism of the process of W-reactivation; (4) B. subtilis strains cured of their defective prophages have been isolated and are now being developed for gene cloning systems; (5) protoplasts of B. subtilis have been shown capable of acquiring DNA repair enzymes (i.e., enzyme therapy); and (6) a plasmid was characterized which enhanced inducible error-prone repair in a gram positive organism.

29351 (LA—8854-SR) **Solar irradiance in clear and polluted atmospheres and potential effects on plant life and climate. Midyear progress report for FY-81 on EPA Project LASLX-A-1.** Gerstl, S.; Zardecki, A. (Los Alamos Scientific Lab., NM (USA)). Jun 1981. Contract W-7405-ENG-36. 12p. NTIS, PC A02/MF A01. Order Number DE81026687.

This 3-year research project, initiated midyear FY-80, has concentrated to date on the implementation of advanced computational methods and data, methods and model validation, and the analysis of realistic pollution scenarios with a quantification of how much the biologically effective solar radiation reaching the ground is reduced due to the presence of energy-related aerosols. The most significant result summarized in this status report indicates a considerable reduction of the biologically effective irradiance at ground level as the aerosol concentration increases. It should also be stresses that the research does not address visibility problems, but rather refers to important questions for our nation's agriculture in relation to air quality and crop yields.

29352 (LA—8913-MS) **Preliminary toxicological study of a component of a hydrogen getter 1,4-diphenylbutadyine (DPB).** Drake, G.A.; London, J.E.; Ott, D.G.; Smith, D.M. (Los Alamos National Lab., NM (USA)). Jul 1981. Contract W-7405-ENG-36. 7p. NTIS, PC A02/MF A01. Order Number DE81028595.

The acute oral LD_{50} values for 1,4-diphenylbutadyine (DPB) in rats and mice were greater than 5 g/kg, except when it was dissolved in corn oil (by sonification); then the LD_{50} was < 1.0 g/kg. According to classical guidelines, the material, when suspended in saline-Triton-X, would be considered slightly toxic or

practically nontoxic in both species. Skin application studies in the rabbit with DPB demonstrated it to be mildly irritating when administered cutaneously. This material was a very mild but transitory irritant in rabbit eye application studies. The sensitization study in the guinea pig did not show the material to be deleterious.

29353 **(LA—8924-MS) Long-term effects of intragastic instillations of BDNPF:BDNPA in male Sprague-Dawley rats and female Swiss-Webster mice.** Smith, D.M.; Drake, G.A.; London, J.E. (Los Alamos Scientific Lab., NM (USA)). Jul 1981. Contract W-7405-ENG-36. 9p. NTIS, PC A02/MF A01. Order Number DE81028597.

Young male Sprague-Dawley rats were given a single dose of 1.3 g/kg body weight (BW) bis-dinitro-propyl-formal:bisdinitro-propyl-acetal (BDNPF:BDNPA) intragastrically (IG) and young female Swiss-Webster mice were given BDNPF:BDNPA either as a single dose (800 mg/kg/Bw) IG or a dose (500 mg/kg/BW) IG on each of 5 consecutive days. All animals were then maintained for the durations of their life spans and autopsied at death. The incidence of testicular Leydig cell tumors and subcutaneous fibrosarcomas in rats receiving the material was significantly elevated compared to controls, though treated animals' life spans were not significantly different from those of control animals. No significant effects were seen in any of the mice receiving either a single dose or multiple doses of BDNPF:BDNPA compared to control animals. We suggest that another species of male Laboratory animals be treated with BDNPF:BDNPA to see if these findings can be replicated.

29354 **(LA-UR—81-1846) Ames/Salmonella mutagenicity assay of natural and synthetic crude oils including a Fischer-Retorted Estonian shale oil.** Strniste, G.F.; Nickols, J.W. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 6p. (CONF-810676—2). NTIS, PC A02/MF A01. Order Number DE81025253.

From 2. joint US-USSR workshop on the health and environmental effects of oil shale development; Tallinn, USSR (22 Jun 1981).

DMSO extracts of a variety of natural and synthetic crude oils were tested for genotoxic activity in the Ames/Salmonella bioassay. Both mutagenic and cytotoxic potentials are cited. Natural crude oils and their refined products and upgraded synfuels are less mutagenic than parent crude shale oils which in turn are less mutagenic than the coal derived distillate blend sample, SRC II. However, this order is not true for cytotoxicity induced by these oil samples; therefore, caution must be exercised in the assessment of their mutagenic potential without consideration of other influential factors including cytotoxicity.

29355 **(LA-UR—81-1847) Comparative inhalation studies with American and Estonian oil shale.** Holland, L.M.; Vigil, E.A.; Gonzales, M.; Tillery, M.I. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 13p. (CONF-810676—3). NTIS, PC A02/MF A01. Order Number DE81025254.

From 2. joint US-USSR workshop on the health and environmental effects of oil shale development; Tallinn, USSR (22 Jun 1981).

This paper presents interim findings on studies comparing the effects of long-term inhalation of quartz, Estonian kukersite, or American Green River shales in rats. No tumors have been observed in the exposed animals. In the studies with Green River shales, the rate of death increased as the animals approached 2 years of exposure. Varying degrees of lung fibrosis has been noted in these animals also. Animals in the kukersite group exhibited only mild changes with some alveolar thickening, and increased macrophages and collagen. Quartz exposed animals suffered severe fibrosis after several months exposure and died after 12 to 15 months.

29356 **(LBL—12905) Development of a methodology to assess organometallic effects on bioenergetic systems.** Packer, L.; Mehlhorn, R.J. (Lawrence Berkeley Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 11p. (CONF-810588—2). NTIS, PC A02/MF A01. Order Number DE81027096.

From DOE/NBS workshop on environmental speciation and monitoring needs; Gaithersburg, MD, USA (18 May 1981).

A methodology for assessing the impact of subacute concentrations of organometallic agents on bioenergetic and oxidative damage processes in animals, cells and energy transducing subcellular organelles is being developed. Several of the assays are noninvasive and thus lend themselves to human tests. At the whole-animal level we utilize a treadmill chamber where physiological parameters of exercising animals are monitored. These include parameters of whole animals' work performance such as oxygen consumption, carbon dioxide evolution and endurance. Oxidative damage can be monitored in experiments by analyzing expired air of the animals for ethane and n-pentane. These alkanes correlate with lipid peroxidation in vivo. At the cellular and subcellular levels, respiratory activity, lipid peroxidation and free radical species are assayed. Respiratory activity is measured in muscle homogenates and isolated mitochondria using substrates which feed into different segments of the electron transport chain. To demonstrate how these assay procedures correlate, iron deficiency anemia in rats was analyzed. Physiologically, iron deficiency caused a 90% decrease in endurance which correlated with an 80% decrease in pyruvate-malate oxidation rates in muscle homogenates. Significant but smaller effects were seen in hemoglobin/hematocrit levels (50% decrease) and in maximal oxygen consumption (50% decrease). Tissue free-radical signals observed by ESR at room temperature increased with exercise.

29357 **(ORNL—5709) Ecotoxicological test systems proceedings of a series of workshops.** Hammons, A.S. (ed.). (Oak Ridge National Lab., TN (USA)). Jun 1981. Contract W-7405-ENG-26. 191p. (EPA—560/6-81-004). NTIS, PC A09/MF A01. Order Number DE81027081.

A series of six workshops was conducted by the Environmental Sciences Division, Oak Ridge National Laboratory, to identify laboratory methods and data evaluation techniques for predicting the environmental effects of chemical substances. Methods were evaluated for their potential for standardization and for use in the ecological hazard and risk assessment processes under the Toxic Substances Control Act. The workshops addressed assessment and policy requirements of multispecies toxicology test procedures, mathematical models useful in hazard and risk assessments, and methods for measuring effects of chemicals on terrestrial and aquatic population interactions and ecosystem properties. The workshops were primarily used as a mechanism to gather information about research in progress. This information was part of the data base used to prepare a critical review of laboratory methods for ecological toxicology.

29358 **(PNL—3640) Incipient toxicity of lithium to freshwater organisms representing a salmonid habitat.** Emery, R.; Klopfer, D.C.; Skalski, J.R. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1981. Contract AC06-76RL01830. 52p. NTIS, PC A04/MF A01. Order Number DE81027142.

Because the eventual development of fusion power reactors could increase the mining, use and disposal of lithium five-fold by the year 2000, potential effects from unusual amounts of lithium in aquatic environments were investigated. Freshwater oganisms representing a Pacific Northwest salmonid habitat were exposed to elevated conentrations of lithium. Nine parameters were used to determine the incipient toxicity of lithium to rainbow trout (Salmo gairdneri), insect larvae (Chironomus sp.), and Columbia River periphyton. All three groups of biota were incipiently sensitive to lithium at concentrations ranging between 0.1 and 1 mg/L. These results correspond with the incipient toxicity of beryllium, a chemically similar component of fusion reactor cores. A maximum lithium concentration of 0.01 mg/L occurs naturally in most freshwater environments (beryllium is rarer). Therefore, a concentration range of 0.01 to 0.1 mg/L may be regarded as approaching toxic concentrations when assessing the hazards of lithium in freshwaters.

29359 **Cadmium resistance correlated with cadmium uptake and thionein binding in CHO cell variants Cd/sup r/20F4 and Cd/sup r/30F9.** Enger, M.D.; Ferzoco, L.T.; Tobey, R.A.; Hildebrand, C.E. (Los Alamos National Lab., NM). *Journal of Toxicology and Environmental Health ;* **7**: No. 5, 675-690(May 1981).

Cadmium-resistant populations were derived by exposing monolayer cultures of Chinese hamster ovary (CHO) cells to step-

wise increments of Cd^{2+} concentration, [Cd^{2+}]. These variants were compared with CHO and with Cd/sup r/2C10, a previously derived clone, in terms of cell survival and Cd^{2+} uptake and partitioning as functions of [Cd^{2+}]. The maximum [Cd^{2+}] to which the various cells may be exposed in suspension culture without effects on growth or survival was 0.2, 2, 26, and 40 μM for CHO, Cd/sup r/2C10, Cd/sup r/20F4, and Cd/sup r/30F9, respectively. Patterns of survival as functions of time exposure to toxic levels of Cd^{2+} differed. Investigation of the role of metallothionein (MT) in conferring protection against Cd^{2+}-mediated cytotoxicity showed that none of the cells is protected significantly by preexisting thionein. In the resistant population Cd^{2+} appears in MT earlier and/or more rapidly than in CHO. Within 4 h of exposure, nuclear and cytoplasmic non-MT Cd^{2+} concentration level off or decrease in the resistant cells, but continue to increase in CHO. These levels are significantly higher in the resistant cells, indicating that there are proportionately more ligands (other than MT) that complex Cd^{2+} in a nontoxic form in these cells. Possible roles of such ligands in Cd^{2+} detoxification and/or thionein induction are discussed.

29360 **Critical concentrations of cadmium in human renal cortex: dose-effect studies in cadmium smelter workers.** Ellis, K.J. (Brookhaven National Lab., NY); Morgan, W.D.; Zanzi, I.; Yasumura, S.; Vartsky, D.; Cohn, S.H. *Journal of Toxicology and Environmental Health ;* **7**: No. 5, 691-703(May 1981).

Cadmium was measured in vivo in the left kidney and liver of 82 industrially exposed workers and 10 control subjects. The range of Cd values for the industrial group was 0.9 to 57 mg for the whole kidney and 0.8 to 120 ppM for the liver, compared to 0.4 to 11.8 mg and 0.6 to 7.9 ppM for the control group. Below 40 ppM in the liver, the kidney Cd burden tended to increase with increasing liver concentration. Above 40 ppM, the kidney Cd content decreased as the liver concentration increased. The biphasic relation between Cd in the kidney and the liver for all subjects showed a critical level of approximately 31 mg Cd in the kidney.

29361 **Effects of sulfuric acid aerosols on pulmonary function of guinea pigs.** Silbaugh, S.A.; Wolff, R.K.; Johnson, W.K.; Mauderly, J.L.; Macken, C.A. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM). Contract EY-76-C-04-1013. *Journal of Toxicology and Environmental Health ;* **7**: No. 3-4, 339-352(Mar 1981).

Forty-seven Hartley guinea pigs were exposed for 1 h to approximately 1 μm (mass median aerodynamic diameter) sulfuric acid aerosols at concentrations that ranged from 1.2 to 48.3 mg/m^3. Eight H_2SO_4-exposed animals exhibited marked increases in total pulmonary resistance and marked decreases in dynamic compliance. Four of these eight responsive animals died during exposure. All other H_2SO_4-exposed animals exhibited no major differences from controls and were termed nonresponsive. The proportion of responsive to nonresponsive animals increased with exposure concentration, but the magnitude of pulmonary function change was similar for all responsive animals regardless of concentration. The results suggest that the Hartley guinea pig reacts to inhaled H_2SO_4 with an essentially all-or-none airway constrictive response and that an animal's sensitivity to this response may be related to its preexposure airway caliber.

29362 **Kinetics of hydrolysis to tetraols and binding of benzo(a)pyrene-7,8-dihydrodiol-9,10-oxide and its tetraol derivatives to DNA. Conformation of adducts.** Geacintov, N.E. (New York Univ., NY); Ibanez, V.; Gagliano, A.G.; Yoshida, H.; Harvey, R.G. Contract AS02-78EV04959;AS02-76EV02386. *Biochemical and Biophysical Research Communications ;* **92**: No. 4, 1335-1342(27 Feb 1980).

When the major reactive metabolite of benzo(a)pyrene, trans-7,8-dihydroxy-anti-9,10-epoxy-7,8,9,10-tetrahydrobenzo(a)pyrene (anti-BPDE) is incubated with DNA in aqueous solution at 25°C, both covalent binding and hydrolysis of anti-BPDE to its tetraols occur. Using fluorescence and absorption spectroscopy it is shown that hydrolysis of anti-BPDE is markedly accelerated by DNA. In the presence of $5A_{260}$ units of DNA per ml in cacodylate buffer solution, at an initial concentration of DNA phosphate/anti-BPDE ratio of 100, both the extent of covalent binding to DNA (<7% of the total anti-BPDE initially present) and hydrolysis of anti-BPDE reach their maximum levels within less than five minutes after mixing. Absorption and electric linear dichroism spectra indicate that the tetraols bind non-covalently to DNA by an intercalation mechanism, whereas the covalent product displays the characteristics of an externally bound complex.

29363 **Deliquescence properties and particle size change of hygroscopic aerosols.** Tang, I.N. (Brookhaven National Lab., Upton, NY). Contract EY-76-C-02-0016. pp 153-167 of Generation of aerosols. Willeke, K. (ed.). Ann Arbor, MI; Ann Arbor Science Publishers, Inc. (1980).

Theoretical and experimental results are presented to show that the growth of a mixed salt aerosol by water vapor condensation may go through several stages of multiphase equilibria before its complete dissolution to form a homogeneous solution droplet. The deliquescence properties are predictable from the phase diagram of the system of interest. The size of a saline droplet in equilibrium with the relative humidity in the surrounding air may be calculated from the thermodynamic properties of the bulk solutions. The increase in particle size as a result of rehydration and condensational growth may significantly affect the retention of inhaled particulates in the respiratory tract. Experiments with $(NH_4)_2SO_4$ and chlorides show that for each deliquescent salt aerosol there is a threshold humidity below which the solution droplets will quickly evaporate to become crystalline particles. The threshold crystallization humidity is generally much lower than the deliquescence humidity of the given salt aerosol. The information should provide a basis for selecting a suitable humidification procedure to generate test aerosols for exposure studies.

29364 **Role of calcium as a micronutrient and its relationships to other micronutrients.** Wallace, A.; ElGazzar, A.; Soufi, S.M. (Univ. of California, Los Angeles). pp 357-366 of 9th International Congress of soil science transactions. Madison, WI; Soil Science Society of America ([nd]).

The Hoagland nutrient solution for growing plants calls for the use of 0.004 or 0.005 M Ca and 0.002 M Mg. Plants grown in such solutions contain about the same amount of Ca as plants grown in soil. In this laboratory some plant species have been grown with Ca levels much lower than that of Hoagland solutions. To accomplish this it was necessary to insure that the Cu level of the solutions was 3×10^{-7} M or less, that unchelated Fe was less than 10^{-5} M and that the Mg level was 10^{-3} M or less. There were some variations due to plant species. Calcium is required by algae and other microorganisms in micronutrient quantities and perhaps also for a gymnosperm. Higher plants seemingly require relatively large quantities of it. The concentrations of it in leaves of higher plants generally range from 0.2 to over 5% of dry weight. There is a large number of experiments which indicate that higher plants benefit from their high Ca contents. When the supply of Ca is low for higher plants, Mg is toxic in moderate quantities and Sr also can be toxic when Ca is low. At high Ca concentrations Sr is not toxic. The purpose of this series of studies was to further explore the ramifications of the relationships between micronutrients and the need for Ca and Sr. There is some evidence that the need for Mg is near that of a micronutrient when the Ca level is also low.

57 HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 28764, 29323, 29324

29365 **(CONF-8106123—1) Nutrition in industrial health at Oak Ridge National Laboratory.** Casey, B.J. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 21p. NTIS, PC A02/MF A01. Order Number DE81024132.

From Union Carbide Corporation medical director's meeting; Chicago, IL, USA (22 Jun 1981).

The nutritional status of an individual plays a key role in the reduction and prevention of illness. This involves maintenance of ideal body weight by using a diet that economically optimizes nutrients. The achievement and maintenance of good health in the industrial population helps us to avoid resource losses. The ORNL nutritional counseling program's major emphasis is to correct and control diet related risk factors to cardiovascular disease.

29366 **(DOE/S—0013) Action plan in response to March 1981 report to NFPQT Committee.** (Department of Energy, Washington, DC (USA)). Mar 1981. 88p. NTIS, PC A05/MF A01. Order Number DE81027291.

This plan of action has been prepared at the direction of the Acting Under Secretary in response to the report of the Nuclear Facilities Personnel Qualifications and Training (NFPQT) Committee on A Safety Assessment of Department of Energy Nuclear Reactors. Senior Department officials with Headquarters responsibilities for the safety of nuclear facilities owned by and operated for the Department have developed this plan with input from the operations office managers having operational responsibility for such facilities. A summary of the plan's objectives and a cross-reference to the findings of the NFPQT Committee Report is attached to the plan. Appendix A contains implementing actions and Appendix B contains a summary of actions responsive to lessons learned from the TMI accident that have been completed or are well underway. Although the plan is written in definitive language, the specific actions (such as organization realignments and proposals) will be subject to appropriate review and approval. Also, other adjustments may be required as the actions are implemented.

29367 **(SAND—81-1576) Special Projects Division quarterly report of progress, 1 April-30 June, 1981.** (Sandia National Labs., Albuquerque, NM (USA)). Jul 1981. Contract AC04-76DP00789. 16p. NTIS, PC A02/MF A01. Order Number DE81027561.

This quarter, the Safety Analysis and Review System briefing and material for a Review Guideline were completed in a form suitable for use by OES in a field and headquarters review/critique process. The briefing was given in Germantown as a part of this process, and the guidance material for reviewing safety analyses was examined by a DOE working group assembled by OES. As a result, some generally minor changes were suggesed that should help improve both items. We were asked unexpectedly by OES personnel during this past quarter to assist in the completion of a Safety Analysis Guideline document. Such assistance was given, and it resulted in a somewhat loosely structured 128-page document that included review guidance as well. A single comprehensive monograph on ES and H Assurance Programs was written and published this quarter. It covers motivation of the need for such programs, their general nature, the ES and H Assurance Program Standard, characteristics of such prorams (including cost-benefit test results), and the existence of the guidelines for implementing ES and H Assurance Programs. The field test of ES and H Assurance Program concepts is progressing smoothly. A method for combining a number of the functions performned by the ES and H Assurance Program Information System was found this quarter.

58 GEOSCIENCES

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 28271, 28306, 28508

29368 **(CONF-800718—(GuideBook)) Post-session field trip guide book.** Borneuf, D.; Ceroici, W.; Gabert, G.; Garven, G.; McLean, A.; Rahmani, R.; Scafe, D.; Stein, R.; Wallick, E.; Wallis, P. (Alberta Research Council, Edmonton (Canada); International Association of Geochemistry and Cosmochemistry, Toronto, Ontario (Canada)). 1980. 50p. NTIS, PC A03/MF A01. Order Number DE81903326.

From 3. international symposium on water-rock interaction; Edmonton, Alberta, Canada (14 Jul 1980).

A guidebook to a field trip through Alberta is presented. The guide discusses the localities visited and some aspects of the hydrogeology and geology of the area. (ACR)

29369 **(SAND—80-2690C) Evaluation of uncertainties in geologic information.** Neal, J.T. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 10p. (CONF-810372—5). NTIS, PC A02/MF A01. Order Number DE81025997.

From Symposium on uncertainties associated with the regulation of the geologic disposal of high-level radioactive waste; Gatlinburg, TN, USA (9 Mar 1981).

Geologic uncertainties in earth models and maps are a fact of life for earth scientists, although the source and in fact existence of such uncertainty is often obscure to those untrained in the earth sciences. Means of systematically treating geologic uncertainty have lagged, especially in decisions that involve comparative data or locations. Our means of treating uncertainty ultimately will influence confidence and credibility in licensing a nuclear waste repository. Most geologic information is interpretive as opposed to factual; however, in either case conclusions commonly are derived from data having unequal reliability. Decisions can take such disparity into account by using information hierarchies, by incorporating more realism into mapping, and by more rigorous quantification of models and maps. Information hierarchies can rank direct measurement (from outcrops, boreholes, etc.) as having greater confidence than indirect measurement (from geophysics, etc.). Mapping realism can be enhanced by showing individual outcrops and by more precisely defining attributes of map units. Recognizing the evolving nature of geologic truth appears to undermine confidence, as does acknowledging the inherent subjectivity in our information base. On the other hand, facing and systematically treating uncertainty ultimately can lead to greater confidence in final decisions.

29370 **(UCID—19081) Fracture mapping for radionuclide migration studies in the Climax granite.** Thorpe, R.; Springer, J. (Lawrence Livermore National Lab., CA (USA)). May 1981. Contract W-7405-ENG-48. 34p. NTIS, PC A03/MF A01. Order Number DE81026676.

As part of LLNL's program on radionuclide migration through fractured rock, major geologic discontinuities have been mapped and characterized at the 420 m level in the Climax Stock, adjacent to LLNL's Spent Fuel Test. Persistence or continuity of features was the principal sampling criterion, and ninety major fractures and faults were mapped in the main access and tail drifts. Although the purpose and nature of this study was different from previous fracture surveys in the Climax Stock, the results are generally consistent in that three predominant fracture sets are identified: NW strike/vertical, NE strike/vertical, NW strike/subhorizontal. The frequency of major features in the main access drift is somewhat higher than in the tail drift. Those mapped in the main access drift are generally braided, stepped, or en echelon, while those in the tail drift appear to be more distinct and planar. Several of the fractures in the tail drift lie in the NE/vertical set, while most form an entirely different set oriented N5E/55NW. Subhorizontal fractures were common to both drifts. An area of seepage associated with some of these low-angle features was mapped in the main access drift.

5802 Geophysics

REFER ALSO TO CITATION(S) 28291, 29216

29371 **(LA—8846-PR) Earthquake catalog for northern New Mexico. Progress report, January-March 1981.** Cash, D.J.; Olsen, K.H.; McFarland, N.J.; Wolff, J.J. (Los Alamos National Lab., NM (USA)). May 1981. Contract W-7405-ENG-36. 13p. NTIS, PC A02/MF A01. Order Number DE81026809.

This report is a summary of the earthquakes located in northern New Mexico by the Los Alamos National Laboratory seismic array. Data are presented in the form of tables and epicenter maps, with a brief explanatory text.

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 28305, 28308, 28313, 28314, 28322

29372 **(RHO-BWI-SA—77) Phase chemistry of the Umtanum basalt, a reference repository host in the Columbia Plateau.** Noonan, A.F.; Fredriksson, K.; Nelen, J. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations; Smithsonian Institution, Washington, DC (USA)). 1980. Contract AC06-77RL01030. 8p. (CONF-801124—51). NTIS, PC A02/MF A01. Order Number DE81026577.

From 3. annual meeting of the Materials Research Society; Boston, MA, USA (17 Nov 1980).

Kilogram quantities of reference Umtanum basalt collected from a surface exposure are compared with Umtanum basalt DC-2 core samples extracted from the central Pasco Basin. The two materials are similar in texture and phase composition, suggesting that sorption, waste/rock/water interaction experiments, and radiation effects studies using reference basalt will successfully simulate the proposed Umtanum repository environment. Textural studies of DC-2 core samples also show that dissolution of mesostasis is restricted to flow top breccia with precipitation of secondary minerals in flow top, entablature, and colonnade sealing fissures and vesicles.

29373 **(SAND—81-0212) Frictional properties of jointed welded tuff.** Teufel, L.W. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1981. Contract AC04-76DP00789. 37p. NTIS, PC A03/MF A01. Order Number DE81027481.

The results of the experiments on simulated joints in welded tuff from the Grouse Canyon Member of the Belted Range Tuff warrant the following conclusions: (1) The coefficient of friction of the joints is independent of normal stress at a given sliding velocity. (2) The coefficient of friction increases with both increasing time of stationary contact and decreasing sliding velocity. (3) Time and velocity dependence of friction is due to an increase in the real area of contact on the sliding surface, caused by asperity creep. (4) Joints in water-saturated tuff show a greater time and velocity dependence of friction than those in dehydrated tuff. (5) The enhanced time and velocity dependence of friction with water saturation is a result of increased creep at asperity contacts, which is in turn due to a reduction in the surface indentation hardness by hydrolytic weakening and/or stress corrosion cracking.

29374 **(SAND—81-0773C) Empirical equation for predicting penetration depth into soft sediments.** Young, C.W. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 4p. (CONF-810911—1). NTIS, PC A02/MF A01.

From Oceans 1981 conference; Boston, MA, USA (16 Sep 1981).

The design and use of kinetic energy marine sediment penetrators require a capability for predicting penetration depth. A natural test target of soft saline clay deposits was chosen for its similarity to marine sediments, and 35 instrumented penetrator tests were conducted. An equation was developed to fit the data with an accuracy of approximately +-15%. The equation includes penetrator mass and diameter, impact velocity, and an index of sediment penetrability. The marine sediment equation is similar in form to a soil penetration equation previously developed. The only sediment related term in the equation is the index of penetrability, which must be estimated from information ranging from a general description to detailed physical properties of the soft sediment. The equation is applicable to very soft saturated clay or soft marine sediments.

29375 **(UCRL—85539) Dynamic measurement of Poisson's ratio in granular materials at 0.2 to. 0.8 GPa.** Olsen, C.W. (Lawrence Livermore National Lab., CA (USA)). Jul 1981. Contract W-7405-ENG-48. 20p. NTIS, PC A02/MF A01. Order Number DE81027559.

Modeling the response of the material surrounding an underground explosion requires a detailed knowledge of the material properties and its equation-of-state. The material is usually porous, granular material whose properties are not well known. We have developed a technique for measurement of Poisson's ratio for shock-loaded, granular material. All tests have been conducted in a 63.5 mm diameter gas-gun. A fixed knife-edge of three thicknesses of 0.3 mm stainless steel was instrumented with carbon stress gauges and Constantan strain gauges. A 0.13 mm stainless steel cover provided gauge protection. The knife-edge was mounted in the target material, dry sand, so as to measure the transverse pressure. By knowing the impact pressure and the orthogonal pressure, Poisson's ratio can be determined. Since the gauges are being loaded edge-on, they must be kept small in the direction of shock propagation. Additionally, the effects of strain are measured with the Constantan gauges and subtraced. In the sand (1.70 Mg/m^3, ~ 37 vol % porosity) we have used so far, the apparent Poisson's ratio increases with impact stress, going from ~ 0.20 at 0.2 GPa to ~ 0.34 at 0.73 GPa. The fixed knife-edge technique, penetrating the target from the back, is apparently more successful than two other techniques considered, instrumenting a rigid wall, and using a floating knife-edge.

29376 **Printed circuits for studying rock mass permeability.** Hudson, J.A.; La Pointe, P.R. (Univ. of Wisconsin, Madison). *International Journal of Rock Mechanics and Mining Sciences and Geomechanics Abstracts ;* **17**: No. 5, 297-301(Oct 1980).

An analog device for studying the degree to which joints are inter-connected and the permeability of rock masses has been described. The printed circuit boards are relatively cheap, costing in total about $20.00 per board in January, 1980 prices.

5805 Oceanography

REFER ALSO TO CITATION(S) 29237

64 PHYSICS RESEARCH

6401 Astrophysics And Cosmology

29377 (BNL—28832, pp 49-52) **Possible applications of synchrotron radiation to x-ray astrophysics.** Delvaille, J.P. (Harvard-Smithsonian Center for Astrophysics, Cambridge, MA). Jan 1981. NTIS, PC A10/MF A01.

From Workshop on atomic physics at the national synchrotron light source; Upton, NY, USA (15 Sep 1980).

As the instrumentation for observations in high energy astrophysics has grown increasingly sophisticated, so too has the need developed for improved calibration techniques and facilities. Contemporary satellite-borne observatories contain high resolution spectrometers, polarimeters and x-ray image-forming optics focussed on position sensitive detectors. The Advanced X-ray Astrophysics Facility, a planned free-flying, shuttle-launched x-ray telescope (1.2 m diameter, 10 m focal length), will provide 0.5 arcsecond imagery over a several arcminute field and spectrometry with $E/\Delta E > 1000$ in the energy range 0.1 to 8 keV. Other telescopes in the planning stage include the possibility of ~ 0.5 arcminute imagery at energies in excess of 100 keV. A few examples from the long list of calibration needs of inidvidual detectors and subsystems are listed as applications of synchrotron radiation.

29378 (BNL—51380, pp 19-26) **Neutrino masses and cosmology.** Witten, E. (Princeton Univ., NJ). 1981. NTIS, PC A15/MF A01.

From Neutrino oscillation workshop; Upton, NY, USA (30 Jan 1981).

A brief review is given of the reasons for renewed theoretical interest in neutrino masses. The possible implications of neutrino masses for cosmology are discussed.

29379 **(LA-UR—81-1907) Linear and nonlinear theory study of Alpha Virginis.** Cox, A.N.; Hodson, S.W.; Clancy, S.P. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 11p. (CONF-8106112—1). NTIS, PC A02/MF A01. Order Number DE81025335.

From Workshop on pulsating B stars; Nice, France (1 Jun 1981).

Nonlinear radiation hydrodynamic calculations using a model for α Virginis, a β Cephei star, have been made to see if the cause of the recurrent radial pulsation epochs can be discovered. The basic observed characteristics of β Cephei variables are pre-

sented. A review of the various proposals to make these stars pulsate concludes that the excitation mechanism must be in the central convective core or variable composition regions. The envelope damps radial fundamental mode pulsations in 4 years and in even shorter periods for radial overtones. It is proposed here that the mixing of envelope hydrogen into the hydrogen depleted (or even exhausted) core can produce periodic pressure pulses which drive the pulsation amplitude up to the observed value. During the decay of the pulsations, evolution toward higher luminosities enables further episodes of mixing and driving to occur. We predict rapid amplitude increases when mixing occurs and a slow decay of radial (and nonradial modes for other β Cephei variables) between mixing episodes.

29380 **(LA-UR—81-1908) Nonradial pulsations of upsilon Orionis and supergiants.** Cox, A.N. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 4p. (CONF-8106112—2). NTIS, PC A02/MF A01. Order Number DE81025338.

From Workshop on pulsating B stars; Nice, France (1 Jun 1981).

The overshooting nonradial mode driving for a pulsating star very close to the main sequence (ν Ori) and for the non radial pulsations of an A supergiant not too unlike α cyg is discussed. (GHT)

29381 **(LBL—12822) Spectrum of four-times ionized niobium, including Zeeman studies of selected lines and laser modification of the population of certain levels in a sliding spark source.** Kagan, D.T. (Lawrence Berkeley Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 93p. NTIS, PC A05/MF A01. Order Number DE81027554.

Thesis.

The $4p^6nl$ spectrum of Nb^{4+} was measured and analyzed. The spectrum was excited in a vacuum sliding spark source with a peak current of 800 amperes and a pulse width of 70 microseconds. The analysis of the spectrum has extended the 13 known lines to 84 and the 10 known levels to 30. The ionization energy was estimated to be 407897 cm^{-1}. There is strong evidence that the $4p^54d^2$ configuration interacts strongly with the $4p^6nf$ configuration. In addition, the hyperfine splitting of the $4p^66s$ level has been observed and measured to be 1.1 cm^{-1}. An attempt was made to examine the Zeeman spectrum of selected lines of Nb^{4+}. However, the Doppler broadening of the lines prevented the acquisition of good results. A complete discussion of the Zeeman effect in the Nb^{4+} spectrum is contained in the test. In addition, the ability of a laser to modify the population of certain atomic levels in the sliding spark source was investigated. The completion of this experiment requires some new equipment.

29382 **Quantization of electromagnetic and gravitational perturbations of a Kerr black hole.** Candelas, P.; Chrzanowski, P.; Howard, K.W. (Institute for Theoretical Physics, University of California at Santa Barbara, Santa Barbara, California 93106). *Physical Review [Section] D: Particles and Fields ;* **24**: No. 2, 297-304(15 Jul 1981).

The electromagnetic and gravitational fluctuations about the classical gravitational field of a rotating black hole are quantized by imposing commutation relations on the Newman-Penrose quantities phi_0 and psi_0. Two examples which illustrate the utility of the formalism concern the vacuum expectation value of the stress-energy tensor for the electromagnetic field in the Boulware vacuum and the response of an Unruh box coupled to fluctuations of the gravitational field. These quantities are computed in the vicinity of the horizon.

29383 **Location of the 1979 April 6 gamma-ray burst.** Laros, J.G.; Evans, W.D.; Fenimore, E.E.; Klebesadel, R.W.; Barat, C.; Hurley, K.; Niel, M.; Vedrenne, G.; Estulin, I.V.; Zenchenko, V.M.; Mersov, G.A. (University of California, Los Alamos Scientific Laboratory). *Astrophysical Journal, Letters to the Editor ;* **245**: No. 2, L63-L66(15 Apr 1981).

A gamma-ray burst was recorded on 1979 April 6 at 1140 UT by instruments on the Pioneer Venus Orbiter (PVO) Venera 11 (V11), Venera12 (V12), Prognoz 7 (P7), and International Sun-Earth Explorer-3 (ISEE-3) spacecraft. The event consisted of a single spike of 0.2 s duration and had a spectral feature near 400 keV (Mazets and Golenetskii), thus resembling the 1979 March 5 events (Mazets et al .; Cline et al .; Evans et al .; Brarat et al.) in two respects. However, important differences in rise time and spectral hardness prevent one from concluding positively that the two events shared the same mechanism or had comparable energetics. Using arrival time analysis we have obtained for the April 6 burst a <1/sub '/ diameter error box centered at $(\alpha, \delta)_{1950} = (23/\text{sup h}/11/\text{sup m}/12/\text{sup s}/,-49°55'39'')$. According to our searches, there is no cataloged object within or suggestively close to this error box. A UK Schmidt plate of the region likewise revealed no images within the error box to m/sub v/ = 22.5. Constraints placed by these findings on the energetics and types of objects that could be responsible for the April 6 and possibly the March 5 bursts are discussed.

29384 **Polarization of the cosmic background radiation.** Lubin, P.M.; Smoot, G.F. (Space Sciences Laboratory and Lawrence Berkeley Laboratory, University of California at Berkeley). *Astrophysical Journal ;* **245**: No. 1, 1-17(1 Apr 1981).

We discuss the technique and results of a measurement of the linear polarization of the cosmic background radiation at a wavelength of 9 mm. Data taken between 1978 May and 1980 February from both the northern hemisphere (Berkeley latitude 38 °N) and the southern hemisphere (Lima latitude 12 °S) over 11 declinations from -37 ° to +63 ° show the radiation to be essentially unpolarized over all areas surveyed. Fitting all data gives the 95% confidence level limit on a linearly polarized component of 0.3 mK for spherical harmonics through third order. A fit of all data to the anisotropic axisymmetric model of Rees yields a 95% confidence level limit of 0.15 mK for the magnitude of the polarized component. Constraints on various cosmological models are discussed in light of these limits.

29385 **Far-infrared observations of globules.** Keene, J. (Enrico Fermi Institute and Department of Astronomy and Astrophysics, The University of Chicago). *Astrophysical Journal ;* **245**: No. 1, 115-123(1 Apr 1981).

Observations of far-infrared emission from nine globules are presented. The intensity and uniformity of the emission confirm that the heat source is the interstellar radiation field. Spectra of B133 and B335 are presented; they are consistent with optically thin thermal emission from dust with temperature 13—16 K. The emissivity of the grains must fall as fast as λ^{-2} for $\lambda > 500$ μm. The temperature and intensity of B335 are used to calculate the ratio of visual extinction to far-infrared emission frequency.

29386 **High resolution X-ray spectra of solar flares. V. interpretation of inner-shell transitions in Fe XX-Fe XXIII.** Doschek, G.A.; Feldman, U.; Cowan, R.D. (E. O. Hulburt Center for Space Research, Naval Research Laboratory). *Astrophysical Journal ;* **245**: No. 1, 315-327(1 Apr 1981).

We discuss high-resolution solar flare iron line spectra recorded between 1.82 and 1.97 A by a spectrometer flown by the Naval Research Laboratory on an Air Force spacecraft launched on 1979 February 24. The emission line spectrum is due to inner-shell transitions in the ions Fe XX-Fe XXV. Using theoretical spectra and calculations of line intensities obtained by methods discussed by Merts, Cowan, and Magee, we derive electron temperatures as a function for time of two large class X flares. These temperatures are deduced from intensities of lines of Fe XXIII, Fe XXII, and Fe XXIV. Previous measurements by us have involved only lines of Fe XXIV and Fe XXV. We discuss the determination of the differential emission measure between about 12 x 10^6 K and 20 x 10^6 K using these temperatures. The possibility of determining electron densities in flare and tokamak plasmas using the inner-shell spectra of Fe XXI and Fe XX is discussed. We also discuss recent theoretical work by Mewe and Schrijver based on atomic data of Grineva, Safronova, and Urnov.

29387 **Ratio of mixing length to scale height in red dwarfs.** Cox, A.N.; Shaviv, G.; Hodson, S.W. (Theoretical Division, Los Alamos Scientific Laboratory). *Astrophysical Journal, Letters to the Editor ;* **245**: No. 1, L37-L40(1 Apr 1981).

Previous completely convective theoretical models of low-mass stars, M< or ≈0.3 M/sub sun/, predict a luminosity-mass relation which is below the observed one. We explain this disagreement by using the latest molecular opacities and by the consequent need to assume an l/H/sub p/ ratio at T<9000 K in the range 0.07—0.17, rather than the more conventional values of 1.0—2.0. When such a low surface layer l/H/sub p/ ratio is assumed, we find significantly higher central temperatures (and hence luminosities) and quite large radiative cores, regardless of the deeper l/H/sub p/ value and equation-of-state uncertainties. The low l/H/sub p/ ratio is explained by the interaction of a magnetic field with convection. Several consequences of this result, including the interstellar abundance of $^3He^+$ are discussed.

29388 **4U 1626—67: A prograde spinning X-ray pulsar in A 2500 s binary system.** Middleditch, J.; Mason, K.O.; Nelson, J.E.; White, N.E. (Lawrence Berkeley Laboratory, University of California, Berkeley). *Astrophysical Journal ;* **244**: No. 3, 1001-1021(15 Mar 1981).

The binary period of 4U 1626—67 has been found from a careful analysis of its optical pulsations. A single lower frequency sidelobe of the 2.4% amplitude 7.68 s optical pulsations from this X-ray pulsar has been detected on at least three different nights in Fourier transforms of high speed photometry obtained with the CTIO 4 m telescope. The 0.42% sidelobe pulsations have a frequency which is 0.4011(21) mHz lower than the frequency of the direct pulsations near 130.26 mHz. The weaker sidelobe pulsations are interpreted as arising from X-ray to optical reprocessing on the companion star and are shifted to the lower frequency by the rotation frequency of the binary because the X-ray pulsar spins in the same sense as as the orbital motion (direct, or prograde). The orbital period is refined by connecting phases to be either 2491.06 s or 2492.32 s +- 0.13 s (the epoch for equal phases for the direct and lower sidelobe pulsations is JD 2,444,048.68162). Third harmonic (3F) structure in the lower sidelobe pulsations has enabled us to detect and measure the Doppler phase modulation due to the projected orbital motion and obtain an inclination-independent measurement of the total orbital separation. A simple geometrical model for the optical pulsations from the companion's Roche lobe is developed to calibrate the systematic effects of the measurements of orbital dimensions.With the help of a new limit of a/sub x/ sin i<0.04 lt-sec established from HEAO 1 data, the corrected values for the orbital parameters are: a/sub c/ sin i = 0.36(10) lt-sec, a/sub x/+a/sub c/ = 1.14(40) lt-sec, i = 18 °(+18 °, -7 °) M/sub x/+M/sub c/ = 1.9(+2.8, -1.4) M/sub sun/, M/sub x/ = 1.8(+2.9, -1.3) M/sub sun/, and M/sub c/<0.5 Msun.

29389 **Neutron star evolution and results from the Einstein X-ray observatory.** Van Riper, K.A.; Lamb, D.Q. (Department of Physics, University of Illinois at Urbana-Champaign, Urbana, IL 61801). *Astrophysical Journal, Letters to the Editor ;* **244**: No. 1, L13-L17(15 Feb 1981).

We reexamine the evolution of neutron stars utilizing current knowledge of their structure and the best microphysics available, including general relativistic effects, improved opacities, and cooling by the emission of neutrinos from a pion condensate or from free quarks. We find that current soft X-ray observations of pulsars and young supernova remnants do not require stars with a pion condensate or free quarks.

29390 **Magnetohydrodynamic origin of Crab Nebula radiation.** Kennel, C.F.; Fujimura, F.S. (Univ. of California, Los Angeles). pp 168-180 of DUMAND-80. Stenger, V.J. (ed.). Honolulu, HI; Hawaii DUMAND Center (1981).

From International DUMAND symposium; Honolulu, HI, USA (24 Jul 1980).

Efforts to construct a self-consistent model that relates pair production near the Crab pulsar to a relativistic wind outflow are reviewed. The nebular radiation is observable only beyond a confining fast magnetohydrodynamic shock. Two improvements were made in the model. (1) The hot relativistic wind has asymptotic properties quite distinct from the classical cold wind model, (2) the Rankine-Hugoniot relation was integrated for highly magnetized shocks. Using these two new pieces of information, it is found that outer gap pair production can account for the nebular radiation, but a polar gap model cannot. The nebular optical radiation can be generated by the post shock thermalized flow. If extremely energetic particles are accelerated at the shock, the MHD model can account quantitatively for the dependence upon photon energy of the apparent size of the x-ray nebula.

6402 Atmospheric Physics

29391 **Simultaneous measurements of magnetotail dynamics by IMP spacecraft.** Fairfield, D.H.; Lepping, R.P.; Hones, E.W. Jr.; Bame, S.J.; Asbridge, J.R. (Planetary Magnetospheres Branch, Laboratory for Extraterrestrial Physics, NASA Goddard Space Flight Center, Greenbelt, Mayland 20771). *Journal of Geophysical Research ;* **86**: No. A3, 1396-1414(1 Mar 1981).

Eleven traversals of the magnetotail at 30-40 R/sub E/ by the IMP 7 and IMP 8 spacecraft ocurred while IMP 6 was making magnetotail measurements inside 33 R/sub E/. Combined magnetic field and plasma data from these spacecraft provide the first demonstration of pressure balance between the high β plasma of the plasma sheet and the strong magnetic fields of the tail lobes. The time variations of this pressure support the view that a southward interplanetary magnetic field enhances the accumulation of energy in a magnetotail energy reservoir. Sometimes the accumulated magnetic energy is rapidly dissipated during a magnetospheric substorm. At other times the dissipation can occur more gradually during ongoing magnetic activity. At such times the energy supplied by the solar wind may even exceed that being dissipated, thus causing the tail energy to increase. In addition to plasma sheet thinnings seem prior to substorm onsets inside ~15 R/sub E/ a gradual decrease in plasma β is detected in the deep tail which precedes onset and the more prominent plasma disappearance that typically accompanies it. The frequency of thinnings and the regions over which they occur indicate that drastic changes in plasma sheet thickness are common features of substorms which occur at all locations across the tail. Several magnetically quiet periods correspond to thick plasma sheets with enhanced B/sub Z/ components and gradually cooling plasmas.

29392 **Timing of energetic proton enhancements relative to magnetospheric substorm activity and its implication for substorm theories.** Belian, R.D.; Baker, D.N.; Hones, E.W. Jr.; Higbie, P.R.; Bame, S.J.; Asbridge, J.R. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Journal of Geophysical Research ;* **86**: No. A3, 1415-1421(1 Mar 1981).

Enhancements of the fluxes of protons having energies of several hundred keV are commonly observed at synchronous orbit and in the magnetotail during geomagnetically active periods. In many cases these flux enhancements have been shown to be closely associated with individual magnetospheric substorms. Using energetic proton data (E/sub p/>0.3 MeV) with synchronous orbiting satellites and from Vela satellites in the magnetotail, we find that the timing of proton enhancements relative to substorm onsets and recoveries (derived from ground magnetic records) and relative to plasma sheet thinnings and recoveries (measured with plasma probes on the Imp 7, Imp 8, and Vela satellites) can be understood in terms of a neutral line model of substorms in which the protons are impulsively accelerated, possibly near the neutral line(s), during a brief period at substorm onset. The energized particles subsequently appear to stream both sunward and antisunward as discrete particle bunches with those flowing sunward observed in the inner magnetosphere as 'drift echoes' and those flowing antisunward seen in the magnetotail as single short, intense 'impulsive' bursts. The more commonly observed rapid-rise slow-decay type of plasma sheet proton enhancements occur during the substorm recovery phase and are, in the present model, attributed to envelopment of the observing satellite by the recovering (i.e., expanding) plasma sheet into which have leaked protons previously injected into the outer radiation zone. We find that many of the energetic proton bursts reported by other research groups, when examined together with concurrent plasma measurements, are also consistent with this model. This paper describes events from our own records and from the published reports of others and offers a unified view of such energetic proton flux enhancements.

29393 Observed signatures of reconnection in the magnetotail. Nishida, A.; Hayakawa, H.; Hones, E.W. Jr. (Institute of Space and Aeronautical Science, University of Tokyo, Komaba, Meguro-ku, Tokyo 153, Japan). *Journal of Geophysical Research ;* **86**: No. A3, 1422-1436(1 Mar 1981).

Plasma and magnetic field data from Imp 6 are examined statistically to study the occurrence of reconnection in the near-earth region (within ~20 R/sub E/) of the magnetotail. It is confirmed that the southward polarity of the magnetic field observed in the low-latitude magnetotail (within a few R/sub E/ of the estimated neutral sheet position) is strongly coupled to a tailward flow of plasma, as expected from the near-earth reconnection model. It is noted, however, that reconnection is not the unique source of the tailward flow, and plasma is seen to be flowing back and forth regardless of the occurrence of near-earth reconnection. It is fast tailward flow having speeds greater than about 400 km/s that is mostly due to near-earth reconnection. There is an indication that detectability of an associated signature in the auroral zone magnetic field is related to the reconnection rate.

29394 Electric fields and plasma waves resulting from a barium injection experiment. Koons, H.C.; Pongratz, M.B. (Space Sciences Laboratory, Ivan A. Getting Laboratories, The Aerospace Corporation, El Segundo, California 90245). *Journal of Geophysical Research ;* **86**: No. A3, 1437-1446(1 Mar 1981).

A shaped-charge, barium plasma injection experiment was performed in June 1976 from the DOE Kauai test facility. The rocket payload contained seven shaped charges, a sevenfold larger package than the typical payloads employed in previous barium plasma injections conducted in this program. An attitude control system oriented the injection perpendicular to the local geomagnetic field. The injection altitude was 450 km. The second-stage motor section contained a payload to measure dc and ac electric fields using a 5-m-long, tip-to-tip dual spherical probe antenna. The ac electric field frequency response was from 100 Hz to 12 kHz. The dc channel responds up to 160 Hz. Shortly after the detonation, the dc electric field was parallel to the geomagnetic field. A few seconds later the measured electric field was the v x B field induced by the motion of the antenna through the plasma. A variety of plasma waves were detected for approximately 20 s following the injection. The initial impulse in the dc channel was measured to be 115 mV/m. The injection generated barium cyclotron waves at 3.4, 7.2, and 10.6 Hz. The barium gyrofrequency at the altitude of the injection was 3.3 Hz. The initial amplitude at 3.4 Hz was 25 mV/m peak-to-peak. These waves were evident in the data for approximately 6 s. Between 3 and 8 after the explosion, band-limited noise was intermittently present between 1.6 and 3.2 kHz. These emissions were lower-hybrid-resonance emissions in a barium plasma. The instability responsible for these emissions is tentatively identified as the modified two-stream instability. Wide-band noise with a decreasing intensity as a function of frequency in the band from 100 Hz to 5 kHz was present from 4 to 30 s following the explosion. The intensity maximized when the antenna was most nearly parallel to the geomagnetic field. This suggests that the waves were ion acoustic waves. Highly structured emission occurred between 500 Hz for several seconds after the explosion.

29395 Prompt striations observed in a barium thermite release at 335 km. Simons, D.J.; Pongratz, M.B.; Smith, G.M.; Barasch, G.E.; Fitzgerald, T.J. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Journal of Geophysical Research ;* **86**: No. A3, 1576-1580(1 Mar 1981).

Three barium clouds have been released from a single rocket at altitudes of 335, 443, and 535 km. The releases were by means of barium thermite injection. Adding the different cross-field velocity components of the rocket at each of the releases resulted in barium clouds with different kinetic velocity distributions. The barium cloud with the most peaked velocity distribution striated promptly, in good agreement with theoretical predictions based on a kinetic plasma instability. Details of the data analysis and experiment are discussed.

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 29082, 29556, 29564, 29566

29396 (BNL—28832) Workshop on atomic physics at the National Synchrotron Light Source. Jones, K.W.; Johnson, B.M.; Gregory, D.C. (eds.). (Brookhaven National Lab., Upton, NY (USA)). Jan 1981. Contract AC02-76CH00016. 210p. (CONF-8009157—). NTIS, PC A10/MF A01. Order Number DE81023507.

From Workshop on atomic physics at the national synchrotron light source; Upton, NY, USA (15 Sep 1980).

The workshop emphasis was to acquaint the atomic physics community with the range of experimental capabilities of the NSLS. (GHT)

29397 (BNL—28832, pp 1-12) Atomic physics research with synchrotron radiation. Crasemann, B. (Univ. of Oregon, Eugene). Jan 1981. NTIS, PC A10/MF A01.

From Workshop on atomic physics at the national synchrotron light source; Upton, NY, USA (15 Sep 1980).

Applications of synchrotron radiation to research in high-energy atomic physics are summarized. These lie in the areas of photoelectron spectrometry, photon scattering, x-ray absorption spectroscopy, time-resolved measurements, resonance spectroscopy and threshold excitation, and future, yet undefined studies. (GHT)

29398 (BNL—28832, pp 13-17) Photoionization of excited states, ions and open-shell atoms: innovative synchrotron experiments. Manson, S.T. (Georgia State Univ., Atlanta). Jan 1981. NTIS, PC A10/MF A01.

From Workshop on atomic physics at the national synchrotron light source; Upton, NY, USA (15 Sep 1980).

The development of synchrotron light sources with increased photon flux in the region 10 eV $\leqq h\nu \leqq$ 1000 eV opens the door to many atomic physics investigations which have not been possible up to now. In this paper, three general types of experiments are discussed, each of which offers attractive possibilities for significant advances in our understanding.

29399 (BNL—28832, pp 19-31) Atomic structure and electron correlations. Kelly, H.P. (Univ. of Virginia, Charlottesville). Jan 1981. NTIS, PC A10/MF A01.

From Workshop on atomic physics at the national synchrotron light source; Upton, NY, USA (15 Sep 1980).

Synchrotron experiments combined with theoretical calculations have already given much information on atomic structure and the effects of electron correlations, and this combination of theory and experiment is expected to yield much new information in coming years. In the calculations of photoabsorption cross sections, it is almost always necessary to include electron correlations in both initial and final states to obtain good agreement with experiment. The main theoretical approaches which include effects of electron correlations have been R-matrix theory, random phase approximation with exchange (RPAE), relativistic random phase approximation with exchange, and many-body perturbation theory (MBPT).

29400 (BNL—28832, pp 43-47) Photoelectron spectroscopy and photoionization experiments on atoms and free molecules. Carlson, T.A. Jan 1981. NTIS, PC A10/MF A01.

From Workshop on atomic physics at the national synchrotron light source; Upton, NY, USA (15 Sep 1980).

The purpose of this exposition is to present a bird's eye view of the value of using synchrotron radiation in the fields of photoelectron and ion spectroscopy of gases.

29401 (BNL—28832, pp 71-78) Apparatus for gas phase studies at $\lambda \geqq$ 300 A. Grover, J.R.; White, M.G. (Brookhaven National Lab., Upton, NY). Jan 1981. NTIS, PC A10/MF A01.

From Workshop on atomic physics at the national synchrotron light source; Upton, NY, USA (15 Sep 1980).

An apparatus is being built to achieve four criteria: (1) a working region of wavelengths from 300 A to 2000 A; (2) absence of all orders higher than the first; (3) intensities as high as possible;

(4) able to deal with a significant gas load in the experimental chamber. In exchange for high intensity and excellent order sorting it is acceptable to have only modest resolution, and to forego wavelengths shorter than 300 A.

29402 (BNL—28832, pp 79-94) **Multiply charged ion sources for photon-ion crossed beam experiments.** Kostroun, V.O. (Cornell Univ., Ithaca, NY). Jan 1981. NTIS, PC A10/MF A01.

From Workshop on atomic physics at the national synchrotron light source; Upton, NY, USA (15 Sep 1980).

The intense beams of synchrotron radiation which will be available from dedicated storage rings such as the x-ray and vuv rings at the National Synchrotron Light Source allow one to contemplate experimental arrangements which can be used to investigate photon-ion interactions in the x-ray and vuv ranges. Studies of multiple charged ions of charge greater than two and their interactions with photons are of great interest because of the general lack of experimental information about the properties of ground and highly excited states of such ions and the important role some multiply charged ions play in astrophysical and laboratory plasmas. Experimental arrangements which would allow the use of photons as probes of such systems would be invaluable in these studies and would help stimulate research in a thus far untouched but increasingly important area of atomic physics. Specific experimental arrangements will depend on the aspects of the interaction being studied, but in general the experiments will be technically difficult and by necessity will involve crossed ion-photon beams with concomitant small interaction rates.

29403 (BNL—28832, pp 95-100) **Constraints on ion beam handling for intersecting beam experiments.** Kruse, T. (Rutgers Univ., New Brunswick, NJ). Jan 1981. NTIS, PC A10/MF A01.

From Workshop on atomic physics at the national synchrotron light source; Upton, NY, USA (15 Sep 1980).

The intense synchrotron radiation beams from the NSLS uv or x-ray storage rings still do not compare in monochromatized photon flux with a laser beam, a fact which becomes apparent in considering reaction rates for interaction of photon and ion beams. There are two prototypical interaction geometries, parallel and perpendicular. Calculations should properly be done in the rest frame of the ion beam; however, expected beta values are small, so the lab frame will be employed and aberration and Doppler shift effects neglected.

29404 (BNL—28832, pp 101-116) **Low energy ion storage devices.** Church, D.A. (Texas A and M Univ., College Station). Jan 1981. NTIS, PC A10/MF A01.

From Workshop on atomic physics at the national synchrotron light source; Upton, NY, USA (15 Sep 1980).

While high energy physicists have found it expedient to store ions at increasingly higher energies in devices of greater size and complexity, atomic physicists have generally attempted to store ions at ever lower energies, and often in miniaturized containers. However, many of the techniques used at both high and low energies are analogous or related. Three basic means of ion containment have been used: the dc electrostatic trap, the Penning-type trap with uniform magnetic field and quadrupole dc potential, and the radio-frequency quadrupole trap in either the cylindrically symmetric or storage-ring configurations. Each trapping configuration has characteristic advantages or drawbacks for particular measurements. Each method is described.

29405 (BNL—28832, pp 137-143) **BNL plans for atomic physics at the NSLS.** Jones, K.W. (Brookhaven National Lab., Upton, NY). Jan 1981. NTIS, PC A10/MF A01.

From Workshop on atomic physics at the national synchrotron light source; Upton, NY, USA (15 Sep 1980).

Present plans for atomic physics experiments at the NSLS which are being developed are described.

29406 (BNL—28832, pp 145-152) **Possible future experiments in atomic physics utilizing synchrotron radiation.** Cooper, J.W. (National Bureau of Standards, Washington, DC). Jan 1981. NTIS, PC A10/MF A01.

From Workshop on atomic physics at the national synchrotron light source; Upton, NY, USA (15 Sep 1980).

The survey is limited to processes in which a single photon is absorbed and either photon attenuation is measured or the end products following absorption are detected. Furthermore, only interactions with free atoms (or positive ions) in their ground states are considered.

29407 (BNL—28832, pp 159-161) **Polarization of photoelectrons produced from atoms by synchrotron radiation.** Hughes, V.W. (Yale Univ., New Haven, CT); Lu, D.C.; Huang, K.N. Jan 1981. NTIS, PC A10/MF A01.

From Workshop on atomic physics at the national synchrotron light source; Upton, NY, USA (15 Sep 1980).

The polarization of photoelectrons from stoms has proved to be an important tool for studying correlation effects in atoms, as well as relativistic effects such as the spin-orbit interaction. Extensive experimental and theoretical studies have been made of the Fano effect, which is the production of polarized electrons by photoionization of unpolarized atoms by circularly polarized light. The experiments have dealt mostly with alkali atoms and with photon energies slightly above the ionization thresholds. Measurements that could be made to utilize polarized radiation are discussed.

29408 (BNL—28832, pp 163-167) **Negative ions, production of slow high-q ions, collisions with inner-shell excited targets using synchrotron radiation.** Smith, W.W. (Univ. of Connecticut, Storrs). Jan 1981. NTIS, PC A10/MF A01.

From Workshop on atomic physics at the national synchrotron light source; Upton, NY, USA (15 Sep 1980).

Tunable xuv radiation is important in atomic and molecular physics for the basic reason that the scale size for electronic binding energies in atoms and molecules is the Rydberg energy unit $hcR = 1/2\ e^2/a_0$ 13.6 eV, corresponding to the hydrogen atom photoelectric threshold wavelength near 910 A. All atoms and molecules will show outer or inner-shell electronic photoabsorption near or somewhat below this wavelength. The combination of high intensity (compared with conventional continuum sources) with monochromaticity and wide-range tunability is needed for systematic absorption spectroscopy of atomic core-excited states. The pioneering work on precision spectroscopy of autoionizing series in atoms was done a number of years ago but there is still considerable interest in this kind of work which should be greatly facilitated with synchrotron radiation. The work is needed for a better understanding of electron-correlation effects in many-electron atoms and of the nature of many-body discrete states embeded in a single-particle continuum.

29409 **Electron attachment to molecules.** Compton, R.N. (Oak Ridge National Lab., TN (USA)). pp 251-262 of Electronic and atomic collisions. Invited papers and progress reports. Oda, N.; Takavanagi, K. (eds.). Amsterdam, Netherlands; North-Holland (1980).

From 11. international conference on the physics of electronic and atomic collisions; Kyoto, Japan (29 Aug 1979).

The author reports on recent progress in the general area of electron attachment to molecules and molecular clusters. Some recent electron-molecule collision studies that are making significant contributions to organic chemistry are mentioned. Recent studies at Oak Ridge National Laboratory on electron attachment to ultracold molecules and molecular clusters are included. Selected data on high Rydberg electron charge exchange with electron attaching molecules is summarized, and the experimental evidence supporting the model of Fermi and Matsuzawa stating the equivalence of Rydberg electrons and slow free electrons is presented. Some of the limitations of the model are also cited.

29410 (CONF-810728—2) **Resonant coherent excitation of fast heavy ions in crystals.** Moak, C.D.; Biggerstaff, J.A.; Crawford, O.H. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 33p. NTIS, PC A03/MF A01. Order Number DE81025187.

From 9. international conference on atomic collisions in solids; Lyon, France (6 Jul 1981).

Hydrogen-like ions of B, C, N, O and F and helium-like ions of N, O and F have been shown to exhibit resonant coherent excitation from their n = 1 to their n = 2 states, caused by periodic

electric potential oscillations which occur as the ion moves through axial or planar chanels of a thin crystal of Au. The resonance velocities of the ions exhibit shifts and splittings which are the result of the crystal fields acting upon the one-, or two-electron ions. Comparisons with theory show fairly good agreement except for certain weak resonance components which do not appear or appear at unexpected values of the resonance velocity.

29411 **(CONF-810728—3(Draft)) Two-atom model in enhanced ion backscattering near 180° scattering angles.** Oen, O.S. (Oak Ridge National Lab., TN (USA)). Jun 1981. Contract W-7405-ENG-26. 13p. NTIS, PC A02/MF A01. Order Number DE81025178.

From 9. international conference on atomic collisions in solids; Lyon, France (6 Jul 1981).

The recent discovery by Pronko, Appleton, Holland, and Wilson of an unusual enhancement of the yield of ions backscattered through angles close to 180° from the near surface regions of solids is investigated using a two-atom scattering model. The model predicts an enhancement effect in amorphous solids whose physical origin arises from the tolerance of path for those ions whose inward and outward trajectories lie in the vicinity of the critical impact parameter. Predictions are given of the dependence of the yield enhancement on the following parameters: ion energy, backscattering depth, exit angle, scattering potential, atomic numbers of projectile and target, and atomic density of target.

29412 **(CONF-810732—1) Ion-reversibility studies in amorphous solids using the two-atom scattering model.** Oen, O.S. (Oak Ridge National Lab., TN (USA)). Jun 1981. Contract W-7405-ENG-26. 28p. NTIS, PC A03/MF A01. Order Number DE81025188.

From Seminar on recent theoretical (computational) developments in atomic collisions in soilds; Strasbourg, France (14 Jul 1981).

An analytical two-atom scattering model has been developed to treat the recent discovery of the enhancement near 180° of Rutherford backscattering yields from disordered solids. In contrast to conventional calculations of Rutherford backscattering that treat scattering from a single atom only (the backscattering atom), the present model includes the interaction of a second atom lying between the target surface and the backscattering plane. The projectile ion makes a glancing collision with this second atom both before and after it is backscattered. The model predicts an enhancement effect whose physical origin arises from the tolerance of path for those ions whose inward and outward trajectories lie in the vicinity of the critical impact parameter. Results using Moliere scattering show how the yield enhancement depends on ion energy, backscattering depth, exit angle, scattering potential, atomic numbers of the projectile and target, and target density. In the model the critical impact parameter and critical angle play important roles. It is shown that these quantities depend on a single dimensionless parameter and analytical expressions for them are given which are accurate to better than 1%.

29413 **(CONF-8009131—2) Role of excited states of molecular ions in structure studies with high-energy collisions.** Kanter, E.P. (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG-38. 82p. NTIS, PC A05/MF A01. Order Number DE81023898.

From NATO International Advanced Study Institute on Molecular ions: geometric and electronic structures; Kos, Greece (30 Sep 1980).

The main features of the Coulomb explosion of fast-moving molecular-ions and the manner in which Coulomb-explosion techniques are being applied to the problem of determining stereochemical structures of light polyatomic ions are described. Examples of such experiments are presented for several ions.

29414 **(DOE/ER/02542—T2) Dynamical studies of molecular systems. Progress report, February 1, 1980-October 27, 1980.** Rabitz, H. (Princeton Univ., NJ (USA). Dept. of Chemistry). 1980. Contract AC02-76ER02542. 13p. NTIS, PC A02/MF A01. Order Number DE81027466.

Research was carried out in the general areas of collision dynamics and chemical kinetics. Research on the following topics was pursued: computational kinetics and sensitivity analysis of hydrogen-oxygen combustion; chemical kinetic functional sensitivity analysis, elementary sensitivities; the selective preparation of excited vibrational states using the stimulated resonance raman effect; an exactly soluble many channel scattering model; further developments and applications of sensitivity analysis to collisional energy transfer; sensitivity analysis of rotational energy transfer processes to the intermolecular potential; a review of vibrational rotational collision processes; sensitivity analysis of differential cross sections to the intermolecular potential; and a non-local formulation of inelastic scattering as a basis for practical approximations.

29415 **(LA—8804-MS) H^0 precessor computer code.** van Dyck, O.B.; Floyd, R.A. (Los Alamos National Lab., NM (USA)). May 1981. Contract W-7405-ENG-36. 43p. NTIS, PC A03/MF A01. Order Number DE81026669.

A spin precessor using H^- to H^0 stripping, followed by small precession magnets, has been developed for the LAMPF 800-MeV polarized H^- beam. The performance of the system was studied with the computer code documented in this report. The report starts from the fundamental physics of a system of spins with hyperfine coupling in a magnetic field and contains many examples of beam behavior as calculated by the program.

29416 **(SAND—81-0850C) Trapping and release of implanted D/H ions in fused silica.** Arnold, G.W.; Doyle, B.L. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 16p. (CONF-810728—1). NTIS, PC A02/MF A01. Order Number DE81024441.

From 9. international conference on atomic collisions in solids; Lyon, France (6 Jul 1981).

Elastic recoil detection techniques have been used to measure hydrogen isotope profiles in fused silica implanted with 20 keV H and/or D ions. Saturation is obtained for both H and D implantations at concentrations of 2.1×10^{21} ions/cm^3, in good agreement with results of gas loading experiments. FTIR measurements indicate that most of the implanted H bonds in the form of OH. Theoretical analyses using the local mixing model (LMM) of H-trapping provide a good fit to the saturation behavior and subsequent H movement toward the surface. Isochronal annealing shows that both H and D are released in a single stage centered about 550°C. The best theoretical fit is for a 1.9 eV H-trap activation energy.

29417 **(SAND—81-1589C) Stimulated Raman studies of CO_2-laser-excited SF_6.** Esherick, P.; Grimley, A.J.; Owyoung, A. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 8p. (CONF-8106100—2). NTIS, PC A02/MF A01. Order Number DE81025829.

From International conference on laser spectroscopy; Alberta, Canada (29 Jun 1981).

A preliminary investigation into the use of SRS for high-resolution studies of transient species is reported. Specifically, SF_6 molecules excited by a CO_2 laser are used as a prototypical system for examining these capabilities. In recent years the discovery of infrared multiphoton dissociation processes in SF_6 has created considerable interest in the vibrational spectroscopy of this molecule. Direct infrared absorption and infrared-infrared double resonance studies have contributed to a better understanding of the infrared excitation processes. Recently, lower spectral resolution time-resolved spontaneous Raman studies of CO_2 laser excited SF_6 have shown the potential utility of Raman probing as a means of studying the excitation dynamics. Since stimulated Raman techniques offer prospects for accessing any desired spectral region with very high temporal and spectral resolving power, they appear well suited to the extension of such studies. Results are reported. (WHK)

29418 **Molecular beam photoionization study of SO_2 and $(SO_2)_2$.** Erickson, J.; Ng, C.Y. (Ames Laboratory, Department of Chemistry, Iowa State University, Ames, Iowa 50011). *Journal of Chemical Physics ;* **75**: No. 4, 1650-1657(15 Aug 1981).

Photoionization efficiency (PIE) data for SO_2^+ have been obtained with a wavelength resolution of 0.14 A (FWHM) in the region 625—1005 A using the molecular beam method. The ioniza-

tion energy (IE) of SO_2 was determined to be 12.348 +- 0.002 eV (1004.08 +- 0.20 A). Similar to the observation in the PIE curve for O_3^+, the spacing for steplike structure observed near the threshold was found to be irregular. Weak structures which arise by autoionization from different vibrational states of Rydberg levels were also resolved in this region. The analysis gives average vibrational spacing of 386, 428, 716, 745, 911, 938, and 956 cm^{-1} for these Rydberg states. The appearance energy (AE) for the photodissociative ionization processes $SO_2+h\nu \rightarrow SO^+ + O + e^-$ and $S^+ + O_2 + e^-$ were measured to be 15.953 +- 0.010 eV (777.2 +- 0.5 A) and 16.228 +- 0.030 eV (764 +- 1.5 A), respectively. Using the AE for the formation of SO^+ from SO_2, and the heats of formation of SO_2, SO, and O, the IE of SO is deduced to be 10.28 +- 0.02 eV. This value is in excellent agreement with that reported previously by Dyke et al. From the observed IE (11.72 +- 0.03 eV) of $(SO_2)_2$, the IE of SO_2, and the estimated binding energy (0.03 eV) of $(SO_2)_2$, the bond dissociation energy of $SO_2^+ \times SO_2$ is found to be 0.66 +- 0.04 eV. Using the measured AE (15.38 +- 0.06 eV) for $S_2O_3 2=$ production from $(SO_2)_2$, a lower bound for the binding energy of $SO^+ \times SO_2$ was calculated to be 0.60 eV.

29419 Examining the accuracy of the infinite order sudden approximation using sensitivity analysis. Eno, L.; Rabitz, H. (Department of Chemistry, Princeton University, Princeton, New Jersey 08544). *Journal of Chemical Physics ;* **75**: No. 4, 1728-1734(15 Aug 1981).

A method is developed for assessing the accuracy of scattering observables calculated within the framework of the infinite order sudden (IOS) approximation. In particular, we focus on the energy sudden assumption of the IOS method and our approach involves the determination of the sensitivity of the IOS scattering matrix S/sup IOS/ with respect to a parameter which reintroduces the internal energy operator h_0 into the IOS Hamiltonian. This procedure is an example of sensitivity analysis of missing model components (h_0 in this case) in the reference Hamiltonian. In contrast to simple first-order perturbation theory a finite result is obtained for the effect of h_0 on S/sup IOS/. As an illustration, our method of analysis is applied to integral state-to-state cross sections for the scattering of an atom and rigid rotor. Results are generated within the $He+H_2$ system and a comparison is made between IOS and coupled states cross sections and the corresponding IOS sensitivities. It is found that the sensitivity coefficients are very useful indicators of the accuracy of the IOS results. Finally, further developments and applications are discussed.

29420 Low energy crossed beam study of the reaction $H^+Z+Ne \rightarrow HNe^+ + H$. Bilotta, R.M.; Farrar, J.M. (Department of Chemistry, University of Rochester, Rochester, New York 14627). *Journal of Chemical Physics ;* **75**: No. 4, 1776-1783(15 Aug 1981).

We present a study of the title reaction over the relative translational energy range 0.87 to 4.05 eV. At all collision energies the products are formed with translational energy significantly in excess of the predictions of the spectator stripping model. Experiments performed with differing values of the reagent mean vibrational energy suggest that the high lying vibrational states of H^+_2 preferentially yield highly internally excited HNe^+ products. We discuss the role of a gradual approach to the potential surface barrier as a mechanism for yielding highly translationally excited HNe^+ products.

29421 Effect of vibration on rotational energy transfer. A quasiclassical trajectory study of $He+H_2$. Thompson, D.L. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics ;* **75**: No. 4, 1829-1834(15 Aug 1981).

Quasiclassical trajectories have been used to compute state-to-state energy transfer cross sections in collisions of He with H_2 initially in high vibrational—rotational states at 0.5 eV collison energy. The results show that for high rotational states (J> or =8) there is significant enhancement of the cross section for rotational energy transfer due to initial vibrational excitation. There is also enhancement of vibrational energy transfer by high initial rotational excitation. Rotational—vibrational energy transfer is the dominant mechanism for relaxation from initial high v, J states.

29422 Location and energetics of transition states for the reactions $H+ClF$, $H+FCl$, $H+F_2$, and $H+Cl_2$. Eades, R.A.; Dunning, T.H. Jr.; Dixon, D.A. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics ;* **75**: No. 4, 2008-2010(15 Aug 1981).

The potential . energy surfaces of the reactions $H+ClF \rightarrow Hcl+F$, $H+FCl \rightarrow HF+Cl$, $H+F_2 \rightarrow HF+F$, and $H+Cl_2 \rightarrow HCl+Cl$ have been investigated using ab initio molecular orbital theory. Calculations were done using polarized double zeta basis sets as the SOGVB+POL—CI level. The barrier heights uncorrected for zero-point effects for the above reactions are 3.2, 9.6, 5.2, and 2.9 kcal/mol, respectively. The transition states for the $H+F_2$ and $H+FCl$ reactions are found to be collinear, while the transition states for the $H+FClF$ and $H+Cl_2$ reactions are found to be bent. The potential surface for a hydrogen migrating from Cl to F in the region of the transition state for $H+ClF$ was found to be very repulsive.

29423 Multiphoton ionization of iodine and benzene: Photoelectron and ion kinetic energy distributions. Miller, J.C.; Compton, R.N. (Chemical Physics Section, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Journal of Chemical Physics ;* **75**: No. 4, 2020-2021(15 Aug 1981).

We have investigated electron and ion kinetic energy distributions following resonantly enhanced multiphoton ionization of I_2 and benzene. The photoelectron spectra demonstrate that n-photon absorption to produce the parent ion in its ground electronic state is the major ionization pathway. Subsequent fragmentation must involve additional photon absorption by the parent ion. The measured kinetic energy distribution of I^+ from I^+_2 is in agreement with that predicted by energy conservation. For benzene, all of the fragment ions have identical, near thermal kinetic energy (0—0.05 eV) distributions implicating a statistical redistribution of the excess energy, rather than sequential absorption and dissociation cycles.

29424 Radiative lifetimes and two-body collisional deactivation rate constants in Ar for $Xe(5p^56p)$,$Xe(5p^56p)$, and $Xe(5p^57p)$ states. Horiguchi, H.; Chang, R.S.F.; Setser, D.W. (Department of Chemistry, Kansas State University, Manhattan, Kansas 66506). *Journal of Chemical Physics ;* **75**: No. 3, 1207-1218(1 Aug 1981).

The radiative lifetimes and collisional deactivation rate constants by argon of four Xe(5p $^6[^2P$/sub 3/2/]6p), three Xe(5p $^6[^2P$/sub 1/2/]6p), and three Xe(5p $^6[^2P$/sub 3/2/]7p) levels, hereafter referred to as Xe(6p), Xe(6p'), and Xe(7p) states, have been measured by a time-resolved laser-induced fluorescence technique in a flowing afterglow apparatus. The deactivation rate constants of the 6p levels are in the (0.5—5) x 10^{-11} cm^3 s^{-1} range; however, the rate constants for the 6p' and 7p levels are much higher with values of (15—40 x 10^{-11} cm^3 s^{-1}. Product states resulting from two-body collisions between the laser excited Xe(6p, 6p', and 7p) atoms and ground state argon atoms were identified from the product emission spectra. In addition to intramultiplet relaxation, considerable intermultiplet transfer to the 6s' levels seems to occur for the Xe(6p) states. Both intramultiplet relaxation and intermultiplet transfer (to the 6d, 5d, and 7s manifolds) are important for the Xe(6p') and Xe(7p) states. Radiative branching ratios for emission in the 450—1100 nm range were measured for several levels. In some cases these ratios can be combined with radiative lifetimes to provide absolute transition probabilities. The lack of reliable branching ratios for the transitions in the infrared is a serious deficiency which prevents the assignment of absolute transition probabilities and also affects the kinetic interpretations for product formation processes.

29425 Interactions of fast HeH^+ beams with matter. Cooney, P.J.; Gemmell, D.S.; Pietsch, W.J.; Ratkowski, A.J.; Vager, Z.; Zabransky, B.J. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). W-31-109-ENG-38. *Physical Review [Section] A: General Physics ;* **24**: No. 2, 746-757(Aug 1981).

We present experimental results from high-resolution studies of the energy and angle distributions for the breakup products that arise from the dissociation of fast-moving $^4HeH^+$ and $^3HeH^+$ in thin carbon foils. These results are compared with calculations

based on a model for the polarization "wakes" induced in foils by the passage of fast charged projectiles. We also describe measurements on the transmission of such fast molecular ions through thin foils and present results on the transmission probabilities, energy losses, and angular distributions of the transmitted ions. A mechanism is proposed to account for these observations on molecular-ion transmission. Related studies on the foil-induced dissociation of OH^+, OH_2/sup +/, CH^+, H_2/sup +/, and $^3He_2$/sup +/ are also briefly reported.

29426 Two- and three-photon ionization in the noble gases. McGuire, E.J. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review [Section] A: General Physics ;* **24**: No. 2, 835-848(Aug 1981).

By using a characteristic Green's function for an exactly solvable Schroedinger equation with an approximation to the central potential of Hermann and Skillman, the cross section for nonresonant two- and three-photon ionization of Ne, Ar, Kr, and Xe were calculated in jl coupling. Expressions for cross sections in jl coupling are given. Comparison with the Ar two-photon cross section of Pindzola and Kelly, calculated using the many-body theory, the dipole-length approximation, and LS coupling shows a disagreement of as much as a factor of 2. The disagreement appears to arise from distortion introduced by shifting the Green's-function resonances to experimental values.

29427 Observation of atomic coherence in laser-exeited uranium vapor. Scarl, D.; Hackel, L.A.; Johnson, M.A.; Rushford, M.C. (Polytechnic Institute of New York, Farmingdale, New York, 11735). *Physical Review [Section] A: General Physics ;* **24**: No. 2, 883-887(Aug 1981).

For the pair of ^{238}U levels at 3868 and 26 558 cm^{-1}, the upper-state population was measured as a function of the irradiance of a resonant exciting pulse of fixed duration. The observed damped Rabi flopping showed that the two-level system was partially coherently excited. The results were compared with the prediction of an exact solution of the time-dependent Schroedinger equation for two-level systems excited by a detuned rectangular pulse. The Schroedinger equation solution, after averaging over laser irradiance fluctuations, agrees well with the data.

29428 Collisions of fast, highly stripped carbon, niobium, and lead ions with molecular hydrogen. Schlachter, A.S.; Berkner, K.H.; Graham, W.G.; Pyle, R.V.; Stearns, J.W.; Tanis, J.A. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review [Section] A: General Physics ;* **24**: No. 2, 1110-1111(Aug 1981).

The range of experimental confirmation of our scaling rule for electron loss from a hydrogen atom in collision with a heavy, highly stripped ion has been considerably broadened by new measurements on carbon-, niobium-, and lead-ion projectiles in molecular hydrogen.

29429 Electron capture in very slow C/sup q/++H collisions. Phaneuf, R.A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Physical Review [Section] A: General Physics ;* **24**: No. 2, 1138-1141(Aug 1981).

An expanding laser-produced plasma has been used as a source of a beam of slow, highly charged carbon ions. Bursts of collimated and energy-selected C/sup q/+ ions were directed through an atomic hydrogen gas target and charge analyzed by time-of-flight methods. Total electron-capture cross sections are reported for C/sup q/++H collisions (q = 3,4,5,6) at energies ranging from 11 to 387 eV/amu and are generally in accord with heretofore untested low-energy theoretical calculations.

29430 Structural determination of molecular overlayer systems with normal photoelectron diffraction: c(2 x 2)CO-Ni(001) and ($\sqrt{3}$ x $\sqrt{3}$)R30° CO-Ni(111). Kevan, S.D.; Davis, R.F.; Rosenblatt, D.H.; Tobin, J.G.; Mason, M.G.; Shirley, D.A.; Li, C.H.; Tong, S.Y. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory, and Department of Chemistry, University of California, Berkeley, California 94720). *Physical Review Letters ;* **46**: No. 25, 1629-1632(22 Jun 1981).

Experimental and theoretical normal photoelectron diffraction studies of CO adsorbed on Ni are presented. It is shown for the first time that normal photoelectron diffraction can yield definitive structure determinations in molecular adsorbate systems. The linear-bonded atop geometry of c(2 x 2)CO-Ni(001) is confirmed, while CO is found to occupy the twofold bridge site in ($\sqrt{3}$ x $\sqrt{3}$)R30° CO-Ni(111).

29431 Ion beam extraction from a plasma with aberration reduction by method of mutual exclusion. Whealton, J.H.; McGaffey, R.W.; Stirling, W.L. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Journal of Applied Physics ;* **52**: No. 6, 3787-3790(Jun 1981).

Using an algorithm for solution of the Poisson-Vlasov equations for ions extracted from a plasma, an electrode shape is considered which has high optimum perveance and low beam divergence.

29432 Diocotron instability in annular relativistic electron beams. Jones, M.E.; Mostrom, M.A. (Intense Particle Beam Theory Group, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). W-7405-ENG. 36. *Journal of Applied Physics ;* **52**: No. 6, 3794-3799(Jun 1981).

A dispersion relation which includes finite axial wavevectors, k, is derived in the rest frame of the beam where the instability is assumed to be electrostatic. The dispersion relation is obtained in the lab frame by a Lorentz transformation. The instability is found to have a finite k bandwidth with the most unstable mode occurring at knot =0. The growth rate for the most unstable mode is found to be reduced by approximately $1/\gamma^2$ from the nonrelativistic result while the real frequency of this mode remains virtually unchanged. The effects of finite v/sub z/ shear, which are left out of the analysis, are estimated and discussed.

29433 H^- ion formation from a surface conversion type ion source. Leung, K.N.; Ehlers, K.W. (Lawrence Berkeley Laboratory, University of California, Berkely, California 94720). W-7405-ENG-48. *Journal of Applied Physics ;* **52**: No. 6, 3905-3911(Jun 1981).

Volume-produced H^- ions have been extracted from a multicusp ion source. In addition, a molybdenum converter is installed in the source to generate surface-produced H^- ions. Without cesium, the production of H^- ions by the surface process is very small compared with those generated by volume production. However, the presence of cesium can greatly enhance the surface production yield. The energy spectrum shows that the surface-generated H^- ions contain two distinct groups when cesium is added to the discharge. The energy of one group is essentially that of the sheath potential and appears to be produced by a desorption process. The second group of H^- ions has a slightly higher energy and appears to be formed by a reflection process. Different types of converter materials have also been tested.

29434 Contributions of multi-electron processes to inner-shell charge transfer and vacancy production: projectile charge dependence in collisions of bare nuclei with argon. Becker, R.L. (Oak Ridge National Lab., TN (USA)); Ford, A.L.; Reading, J.F. (Texas A and M Univ., College Station (USA). Cyclotron Inst.; Texas A and M Univ., College Station (USA). Dept. of Physics). *Journal of Physics B: Atomic and Molecular Physics ;* **13**: No. 20, 4059-4077(28 Oct 1980).

Previous coupled-channel calculations of inner-shell charge transfer and vacancy production for p + Ar collisions are extended to bare projectiles with nuclear charges Zsub(p) = 2 and 6 in the collision energy range from 1 to 9 MeV amu^{-1}. An improved expression for the charge transfer amplitude is derived in a 'distorted-phase' formulation of the impact parameter method providing a better treatment of the contributions from the long-range parts of the interaction potentials. The charge transfer cross sections are found to increase with projectile charge Zsub(p) less rapidly than the Z^2sub(p) predicted by the OBK approximation. Results are compared with those of previous workers.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 28994

29435 **(LA—8802-M) RAVEN physics manual.** Oliphant, T.A. (Los Alamos National Lab., NM (USA)). Jun 1981. Contract W-7405-ENG-36. 25p. NTIS, PC A02/MF A01. Order Number DE81026811.

This document is an exposition of the physics in the RAVEN code and the numerical methods used in implementing the physics.

29436 **(LA—8908-MS) ORBEOS: a spherical, fully multidimensional flux-corrected transport-hydrodynamics code.** Scannapieco, A.J. (Los Alamos Scientific Lab., NM (USA)). Jul 1981. Contract W-7405-ENG-36. 29p. NTIS, PC A03/MF A01. Order Number DE81026427.

ORBEOS is a two-dimensional (r-θ), Eulerian hydrodynamics code with tabular equation of state (EOS), that uses a fully multidimensional flux-corrected transport algorithm to solve the fluid equations. This flux-corrected transport (FCT) algorithm, developed by S.T. Zalesak, is Cartesian and accurate to any desired order in space and to second order in time. The algorithm used in ORBEOS was modified for spherical geometry and is accurate in space to fourth order. Although this algorithm has been used before to solve the continuity equation, it is used in ORBEOS for the first time as the basic algorithm in a full hydrocode. The physical equations solved in the code and their finite-difference representations are described, and it is shown why the fully multidimensional algorithm better represents incompressible flows and does not lead to virtual sources as does the older one-dimensional FCT algorithm using Strang-type time-step differencing to handle multidimensional problems. Several test problems are presented and discussed.

29437 **Model grand potential for a nonuniform classical fluid.** Percus, J.K. (Courant Institute of Mathematical Sciences and Physics Department, New York University, New York, New York 10012). *Journal of Chemical Physics ;* **75**: No. 3, 1316-1319(1 Aug 1981).

Classical equilibrium statistical mechanics of one-dimensional hard cores in an arbitrary external field is reviewed. The grand canonical potential is shown to be an extension of local thermodynamics in which suitable averages of density and pressure are used. A general three-dimensional system with arbitrary internal and external potentials is modeled in corresponding form, and the external potential represented as a functional of the density. Comparison with assumed bulk data permits evaluation of the required averages. It is shown that the wall equation of state for a wall-bounded fluid is satisfied exactly. Application is also made to the self-maintained density profile of the two-phase fluid at a first order phase transition.

29438 **Kinetic mean-field theories.** Karkheck, J.; Stell, G. (Department of Mechanical Engineering, State University of New York at Stony Brook, Long Island, New York 11794). *Journal of Chemical Physics ;* **75**: No. 3, 1475-1487(1 Aug 1981).

A kinetic mean-field theory for the evolution of the one-particle distribution function is derived from maximizing the entropy. For a potential with a hard-sphere core plus tail, the resulting theory treats the hard-core part as in the revised Enskog theory. The tail, weighted by the hard-sphere pair distribution function, appears linearly in a mean-field term. The kinetic equation is accompanied by an entropy functional for which an H theorem was proven earlier. The revised Enskog theory is obtained by setting the potential tail to zero, the Vlasov equation is obtained by setting the hard-sphere diameter to zero, and an equation of the Enskog—Vlasov type is obtained by effecting the Kac limit on the potential tail. At equilibrium, the theory yields a radial distribution function that is given by the hard-sphere reference system and thus furnishes through the internal energy a thermodynamic description which is exact to first order in inverse temperature. A second natural route to thermodynamics (from the momentum flux which yields an approximate equation of state) gives somewhat different results; both routes coincide and become exact in the Kac limit. Our theory furnishes a conceptual basis for the association in the heuristically based modified Enskog theory (MET) of the contact value of the radial distribution function with the "thermal pressure" since this association follows from our theory (using either route to thermodynamics) and moreover becomes exact in the Kac limit. Our transport theory is readily extended to the general case of a soft repulsive core, e.g., as exhibited by the Lennard-Jones potential, via by-now-standard statistical—mechanical methods involving an effective hard-core potential, thus providing a self-contained statistical—mechanical basis for application to such potentials that is lacking in the standard versions of the MET. Thermal conductivity and shear viscosity of several saturated simple liquids agree with experiment.

29439 **Finite element simulations of steady, two-dimensional, viscous incompressible flow over a step.** Leone, J.M. Jr.; Gresho, P.M. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). W-7405-ENG-48. *Journal of Computational Physics ;* **41**: No. 1, 167-191(May 1981).

The Galerkin finite element method is utilized to obtain quite detailed results for flow through a channel containing a step at Reynolds numbers of 0 and 200. This technique, however, like its centered finite difference counterpart, is prone to generating wiggles or oscillations when streamwise gradients become too large to be resolved by the mesh. These wiggles are carefully analyzed and are used as a guide in obtaining accurate solutions via successive mesh refinement. It is argued that the appropriate solution to the wiggle problem is the utilization of selective grid refinement (easily available via isoparametric finite elements) rather than taking recourse to upwind methods which effectively reduce the local Reynolds number and thereby generate deceptively smooth and often inaccurate results.

29440 **Numerical test of the reliability of Galerkin approximations to the solutions of the Navier—Stokes equation.** Treve, Y.M. (La Jolla Institute, La Jolla, California 92038). DE-A503-78ET53072. *Journal of Computational Physics ;* **41**: No. 1, 217-222(May 1981).

The accuracy of the Galerkin method for solving the Navier-Stokes equation is tested for a two-dimensional incompressible viscous flow.(AIP)

6450 High Energy Physics

29441 **(DOE/ER/03230—1) Research in elementary particle physics. Technical progress report, May 1, 1980-April 30, 1981.** Kirsch, L.E.; Schnitzer, H.J. (Brandeis Univ., Waltham, MA (USA). Dept. of Physics). 1981. Contract AS02-76ER03230. 17p. NTIS, PC A02/MF A01. Order Number DE81025964.

Research in theoretical and experimental properties of elementary particles is described. This includes measurements made at the multiparticle spectrometer facility at Brookhaven, studies of baryonium production, inclusive hyperon production, and E^0 production. Theroetical work included extended field theories, subconstituent models, finite temperature QCD, grand unified theories, and calculational techniques in gauge theories. (GHT)

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 29184, 29525

29442 **(BNL—51380) Neutrino oscillation workshop.** Baggett, N. (comp.). (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 332p. (CONF-810135—). NTIS, PC A15/MF A01.

From Neutrino oscillation workshop; Upton, NY, USA (30 Jan 1981).

Topics covered in the workshop include: extra-terrestrial and reactor neutrinos; accelerator neutrinos; neutrino mass; neutrino oscillations; and intense neutrino beams. (GHT)

29443 (BNL—51380, pp 27-41) **Phenomenological analysis of reactor data for neutrino oscillations.** Silverman, D. (Univ. of California, Irvine); Soni, A. 1981. NTIS, PC A15/MF A01.

From Neutrino oscillation workshop; Upton, NY, USA (30 Jan 1981).

Reactor data from experiments performed at different distances is analyzed without using any theoretically calculated reactor anti ν/sub e/ spectra. The data does not support the no oscillation hypothesis and exhibit distance dependence in the form of depletion of anti ν/sub e/ (of energy $\sim >$ 6 MeV) with increase in distance from 6.5m to 11.2m. Three solutions with oscillations among two neutrinos jointly fit the data. These have the (δ m^2, sin^{2}2 θ) values: ($\sim$ .9 eV^2, $\sim$ .29); ($\sim$ 2.2 eV^2, $\sim$ .17); ($\sim$ 3.7 eV^2, $\sim$ .23). Each one of these solutions is within the (68% CL) allowed region in the (δ m^2, sin^{2}2 θ) space of Boehm et al.'s analysis of their own experiment at 8.7m. The reactor anti ν/sub e/ spectrum deduced in conjunction with each of these oscillation solutions is found to be compatible with the spectrum obtained by inversion of the measured beta spectrum from fission of ^{235}U.

29444 (BNL—51380, pp 61-99) **Results of a 150 MeV ν/sub μ/ oscillation experiment at the BNL and implications for future experiments.** Cortez, B. (Harvard Univ., Cambridge, MA); LoSecco, J.; Sulak, L.; Soukas, A.; Weng, W. 1981. NTIS, PC A15/MF A01.

From Neutrino oscillation workshop; Upton, NY, USA (30 Jan 1981).

A sensitive search for neutrino oscillations is reported. A pure ν/sub μ/ beam of low energy was constructed at the Brookhaven AGS. The appearance of any ν/sub e/ in the beam would signify oscillations. To maximize sensitivity the energy of the neutrino beam was reduced to 150 MeV. The existing neutrino beam line and a 30T liquid scintillation calorimeter used in previous νp scattering experiments were utilized.

29445 (BNL—51380, pp 101-121) **Neutrino oscillation experiments at CERN.** Rothberg, J.E. (Univ. of Heidelberg, Germany). 1981. NTIS, PC A15/MF A01.

From Neutrino oscillation workshop; Upton, NY, USA (30 Jan 1981).

Two proposals for neutrino oscillation experiments have been submitted at CERN at this time. A Padova-Pisa-Athens-Wisconsin group proposes to use BEBC to observe ν/sub e/ events in a nearly pure ν/sub μ/ beam, and the CERN-Dortmund-Heidelberg-Saclay group proposes to use the neutrino detector presently installed in the SPS high energy neutrino beam to look for the disappearance of ν/sub μ/. The main features of the two experiments are presented and discussed.

29446 (BNL—51380, pp 123-134) **Neutrino oscillation studies at Fermilab.** Roe, B.P. (Univ. of Michigan, Ann Arbor). 1981. NTIS, PC A15/MF A01.

From Neutrino oscillation workshop; Upton, NY, USA (30 Jan 1981).

This talk will be divided into two parts. In the first part, some of the present Fermilab neutrino oscillation limits are reviewed. The second part describes a new Fermilab experiment just now getting under way.

29447 (BNL—51380, pp 153-169) **Intense ν/sub e/ beams using stored muons at Brookhaven.** Grannis, P.D.; Marx, M. (SUNY, Stony Brook, NY). 1981. NTIS, PC A15/MF A01.

From Neutrino oscillation workshop; Upton, NY, USA (30 Jan 1981).

A proposal is presented for constructing a ν/sub e/(anti ν/sub e/) beam at BNL whose content and flux can be easily determined. The original motivation for this study was to find alternatives to building large new detectors, far ($\sim$ 1km) from the AGS, in order to effectively study neutrino oscillation phenomena. Such new detectors would likely be quite costly and perhaps somewhat limited in their ability to identify reaction products and in their resolution. It is felt that there are also large potential problems in flux determinations in experiments employing widely separated detectors and distributed neutrino sources. The good e-μ identification properties of the E734 detector could be exploited by producing a suitable ν/sub e/ beam - as opposed to use of the existing ν/sub μ/ beam and new detectors of cruder character placed at much greater distances. The use of a muon storage ring (μSR) should be superior to a beam from K/sub L/^{0} decays, both in flux and in the ability to calculate the beam content. Although such a source is envisioned in conjunction with the E734 detector, a μSR could easily provide neutrinos for several detectors operating concurrently. Additionally, it might open new possibilities in neutrino physics beyond oscillation phenomena, such as the determination of the sign of the interference of the weak charged and neutral currents by measurement of the ν/sub e/-electron elastic scattering cross section.

29448 (BNL—51380, pp 189-216) **Dedicated search for the time evolution of an electron neutrino beam at the Brookhaven AGS.** Bionta, R. (Univ. of Michigan, Ann Arbor); LoSecco, J.; Ong, R.; Stone, J.; Sulak, L.; Watts, R.; Cortez, B.; Foster, G.W. 1981. NTIS, PC A15/MF A01.

From Neutrino oscillation workshop; Upton, NY, USA (30 Jan 1981).

An experiment dedicated to the study of the time evolution of a neutrino beam enriched with ν/sub e/'s is suggested as feasible. It appears that the highest fluxes can be achieved with current beam lines at the Brookhaven AGS or the CERN PS. A configuration optimized for good sensitivity to neutrino eigenmass differences from 1 eV to 20 eV and mixing (Pontecorvo) angles down to 15^0 (comparable to the Cabibbo angle) is considered. The ν/sub e/ beam is formed using K/sub e3/^{0} decays. A simultaneously produced ν/sub μ/ beam from K/sub μ3/^{0} decay serves as the normalizer. Pion generated ν/sub μ/'s are suppressed to limit background. A massive detector is employed to obtain sufficient statistical power. It consists of a series of seven water Cerenkov modules (each with 180T fiducial mass), judiciously spaced along the ν line to provide flight paths from 40 m to 1000 m. The detector elements duplicate a recently developed technology that is eminently suited to this investigation. Simulation and reconstruction of neutrino events in a detector similar to the one suggested show sufficient resolution in angle, energy, position and event timing relative to the beam.

29449 (BNL—51380, pp 217-228) **Optimizing the event rate in a ν/sub μ/ disappearance oscillation experiment.** Chen, H.H. (Univ. of California, Irvine). 1981. NTIS, PC A15/MF A01.

From Neutrino oscillation workshop; Upton, NY, USA (30 Jan 1981).

Neutrino oscillation experiments at medium energy have been considered, e.g., BNL E704 and P764 using the AGS at 800 MeV, and many proposals at LAMPF. One reason for this is that since existing neutrino detectors are at a fixed L, one should go to lower neutrino energies to gain increased geometric sensitivity to δ m^2. Another reason for doing oscillations at lower energy is that the available proton current can be very high, e.g., LAMPF produces 1 mA at 800 MeV.

29450 (BNL—51380, pp 229-238) **Measurement of the β-spectrum of ^{3}H with a Si(Li) detector for determining electron antineutrino mass.** Simpson, J.J. (Univ. of Guelph, Ontario). 1981. NTIS, PC A15/MF A01.

From Neutrino oscillation workshop; Upton, NY, USA (30 Jan 1981).

An experiment to measure the β-energy spectrum of tritium implanted in a Si(Li) x-ray detector has been investigated as a method to determine the mass of the electron anti-neutrino and the ^{3}H-^{3}He atomic mass difference. Present results imply a mass $<$65 eV with 95% confidence and an end-point energy of 18567 +- 5 eV. The β-spectrum has also been investigated for evidence of coupling of the neutrino to neutrinos of mass between 100 eV and 10 keV and upper limits to the coupling strength are obtained. It is also pointed out that the lower bounds on neutrinoless double-β decay lifetimes give very stringent limits on the mixing of heavy Majorana neutrinos ($<$ a few MeV) to the dominantly coupled low mass neutrino.

29451 (BNL—51380, pp 249-287) **Implications of neutrino masses and mixing for weak processes.** Shrock, R.E. (State Univ. of New York, Stony Brook). 1981. NTIS, PC A15/MF A01.

From Neutrino oscillation workshop; Upton, NY, USA (30 Jan 1981).

A general theory is presented of weak processes involving neutrinos which consistently incorporates the possibility of nonzero neutrino masses and associated lepton mixing. The theory leads to new tests for and bounds on such masses and mixing. These tests make use of (π,K)/sub l2/ decay, nuclear β decay, and μ and tau decays, among others. New experiments at SIN and KEK to apply the tests are mentioned. Further, some implications are discussed for (1) the analysis of the spectral parameters in leptonic decays to determine the Lorentz structure of the weak leptonic couplings; (2) fundamental weak interaction constants such as G/sub μ/, G/sub V/', f/sub π/, f/sub K/, V/sub uq/, q = d or s, m/sub W/, and m/sub Z/; and (3) neutrino propagation.

29452 **(DOE/ER/01195—T1) Annual progress report.** Wattenberg, A.; Simmons, R.O. (Illinois Univ., Urbana (USA). Dept. of Physics). May 1981. Contract AC02-76ER01195. 38p. (COO—1195-462). NTIS, PC A03/MF A01. Order Number DE81025555.

Elementary particle physics research at the University of Illinois and at high energy particle accelerator laboratories operated by DOE is described. Major accomplishments in 1980 include: determination of the diffractive cross section for production of charmed D mesons in π^-p collisions at 215 GeV/c to be 20 μb; data acquisition for π^- beryllium at 215 GeV/c; construction and testing of prototype muon drift tubes for the p anti p detector facility; Monte Carlo studies of the muon trigger rates, background levels and resolutions were done; results of photoproduction for 70 to 200 GeV photons gave cross-sections of 160 +- 70 nb and 390 +- 190 nb per nucleon respectively; the cross-section for photoproduction of the charmed Λ/sub c/ baryon was measured; and development of the FASTBUS system. (GHT)

29453 **(DOE/ER/01195—T2) Neutrino-proton and anti-neutrino-proton elastic scattering.** Fuess, S.C. (Illinois Univ., Urbana (USA)). 1981. Contract AC02-76ER01195. 179p. (COO—1195-463). NTIS, PC A09/MF A01. Order Number DE81025552.

Thesis.

An experiment performed at the Brookhaven National Laboratory Alternating Gradient Synchrotron observed the elastic scattering of neutrinos and anti-neutrinos from a nuclear target. The neutral current anti-neutrino to neutral current neutrino ratio is: $\sigma(\text{anti } \nu p \rightarrow \text{anti } \nu p)/\sigma(\nu p \rightarrow \nu p) = 0.45 \pm 0.18$ for $0.33 \leq Q^2 \leq 1.0$ (GeV/c)^2, where Q^2 is the square of the momentum transfer to the nucleon. The neutrino neutral current to charged current ratio is: $\sigma(\nu p \rightarrow \nu p)/\sigma(\nu n \rightarrow \mu^- p) = 0.13 \pm 0.04$ for $0.25 \leq Q^2 \leq 1.0$ (GeV/c)^2. The ratios are consistent with a value of the Weinberg angle of $\sin^2\theta$/sub w/ = 0.26 +- 0.08.

29454 **(DOE/ER/05007—17) Particle theory, cosmology, and relativity. Progress report, July 1, 1980-June 30, 1981.** Gaisser, T.K.; Steigman, G.; Halprin, A. (Delaware Univ., Newark (USA). Bartol Research Foundation). 24 Jun 1981. Contract AS02-78ER05007. 7p. NTIS, PC A02/MF A01. Order Number DE81027462.

This work covers several aspects of particle theory and phenomenology, including the results of related fields which bear on high energy physics. Major topics under study are cosmic rays and particle phenomenology, cosmology and particle physics, weak interaction theory, and relativity and nonlinear differential systems.

29455 **(DOE/ER/13065—T2) Prompt single muon production by protons on iron.** Bodek, A.; Breedon, R.; Coleman, R.N. (Rochester Univ., NY (USA). Dept. of Physics and Astronomy). 1981. Contract AC02-76ER13065. 7p. (COO—3065-299; UR—783). NTIS, PC A02/MF A01. Order Number DE81026195.

A new experiment has been performed at Fermilab to measure the hadronic production of prompt single muons. A preliminary analysis of a sample of the data indicates approximately equal production of prompt single μ^+'s and μ^-'s in 350 GeV p-Fe interactions. The observed momentum distributions of prompt single μ^+'s and μ^-'s can satisfactorily be fit by the hypothesis of central production of D mesons with a cross section of 16 +- 4 μb/nucleon.

29456 **(DOE/ER/70149—T1) High-energy-physics studies. Progress report, October 1, 1974-September 30, 1975.** Condon, P.E.; Schultz, J. (California Univ., Irvine (USA). Dept. of Physics). 1975. Contract AT03-76ER70149. 80p. NTIS, PC A05/MF A01. Order Number DE81026731.

Progress is reported on research conducted by the High Energy Physics Group of the Irvine campus of the University of California, during the contract year beginning October 1, 1974. Work was performed on six projects: completion of the analysis of proton-antiproton interactions between 0.1 and 1.1 GeV/c; analysis of an exposure in the 30 inch BNL bubble chamber with deuterium fill; running and analysis of an experiment to study K°/sub L/p interactions in the momentum range 2 to 6 GeV/c; preparation of an experiment to study production of massive mu pairs in K°/sub L/-nucleon interactions; preparation of an experiment to study direct electron production at SLAC-SPEAR; and analysis of small angle pp data from CERN-ISR.

29457 **(LBL—92) Compilation of high energy physics reaction data: inventory of the particle data group holdings 1980.** Fox, G.C.; Stevens, P.R.; Rittenberg, A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1980. Contract W-7405-ENG-48. 129p. (CALT—68-821). NTIS, PC E11/MF $15.50. Order Number DE81027630.

Includes 66 sheets of 48x reduction microfiche.

A compilation is presented of reaction data taken from experimental high energy physics journal articles, reports, preprints, theses, and other sources. Listings of all the data are given, and the data points are indexed by reaction and momentum, as well as by their source document. Much of the original compilation was done by others working in the field. The data presented also exist in the form of a computer-readable and searchable database; primitive access facilities for this database are available.

29458 **(LBL—12814) Elastic and inelastic psi production by muons.** Loken, S.C. (Lawrence Berkeley Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 10p. (CONF-810376—3). NTIS, PC A02/MF A01. Order Number DE81025326.

From 16. rencontre de moriond: nonperturbative QCD: theory and experiment; Les Arcs, France (15 Mar 1981).

Results are presented on the elastic and inelastic production of psi (3.1). The elastic data are qualitative agreement with the predictions of photon-gluon fusion but have a steeper dependence on Q^2 than the model predicts. A QCD calculation accounts well for the shape of the inelastic data in inelasticity, Q^2 and E/sub γ/, but fails to account for the absolute cross section. At 209 GeV, the cross-section for elastic psi production is 0.36 +- 0.07 nb; for inelastic, 0.28 +- 0.06nb.

29459 **(UCR—34-P107-263) Annual report, January 1-December 31, 1979.** Kernan, A.; Poe, R.T. (California Univ., Berkeley (USA)). Dec 1979. Contract AM03-76SF00034. 33p. NTIS, PC A03/MF A01.

High-energy-physics research conducted by UC Riverside during 1979 is summarized. Subject areas include: heavy-ion physics; the Lampshade magnet; a general PEP detector based on the time projection chamber; and proton antiproton interactions at cm energy of 600 GeV. (GHT)

29460 **Charm production by muons and its role in scale noninvariance.** Gollin, G.D.; Shoemaker, F.C.; Surko, P.; Clark, A.R.; Johnson, K.J.; Kerth, L.T.; Loken, S.C.; Markiewicz, T.W.; Meyers, P.D.; Smith, W.H.; Strovink, M.; Wenzel, W.A.; Johnson, R.P.; Moore, C.; Mugge, M.; Shafer, R.E. (Joseph Henry Laboratories, Princeton University, Princeton, New Jeresy 08544). *Physical Review [Section] D: Particles and Fields ;* **24**: No. 3, 559-589(1 Aug 1981).

Interactions of 209-GeV muons in the multimuon spectrometer at Fermilab have yielded more than 8 x 10^4 events with two muons in the final state. After reconstruction and cuts, the data

contain 20 072 events with (81 +- 10)% attributed to the diffractive production of charmed states decaying to muons. The cross section for diffractive charm muoproduction is 6.9/sup +1.9//sub -1.4/ nb where the error includes systematic uncertainties. Extrapolated to $Q^2 = 0$ with $\sigma(Q^2) = \sigma(0)(1+Q^2/A^2)^{-2}$, the effective cross section for 178- (100-) GeV photons is 750^{+180}/sub -/130 (560^{+}/sub -/$^{2}{}_{1}{}^{0}{}_{2}{}^{0}$) nb and the parameter A is 3.3 +- 0.2 (2.9 +- 0.2) GeV/c. The ν dependence of the cross section is similar to that of the photon-gluon-fusion model. Okubo-Zweig-Iizuka selection rules and unitarity allow the muon data to set a 90%-confidence lower limit on the psiN total cross section of 0.9 mb. A first determination of the structure function F_2(cc-bar) for diffractive charm production indicates that charm accounts for approximately 1/3 of the scale noninvariance observed in inclusive muon-nucleon scattering at low Bjorken x.

29461 **A/sub y/(Θ) for p+ ^{208}Pb elastic scattering at 0.8 GeV and a test of multiple scattering theory.** Hoffmann, G.W.; Ray, L.; Barlett, M.; Coker, W.R.; McGill, J.; Adams, G.S.; Igo, G.J.; Irom, F.; Wang, A.T.M.; Whitten, C.A. Jr.; Boudrie, R.L.; Amann, J.F.; Glashausser, C.; Hintz, N.M.; Kyle, G.S.; Blanpied, G.S. (University of Texas, Austin, Texas 78712). *Physical Review* [*Section*] *C: Nuclear Physics ;* **24**: No. 2, 541-551(Aug 1981).

New, large-momentum-transfer 0.8 GeV p+ ^{208}Pb elastic analyzing power data are presented and compared to optical model predictions using the Kerman-McManus-Thaler microscopic optical potential. This comparison provides an important test of multiple scattering theories since the predictions are quite sensitive to the assumed nucleon-nucleon scattering amplitudes and are not sensitive to the details of the nuclear densities. We show that improvement in the agreement between experiment and a parameter-free theoretical prediction is obtained when the calculation includes the electromagnetic spin-orbit potential which arises from the coupling of the projectile proton's magnetic moment and the Coulomb field of the target nucleus. The sensitivity of the predicted analyzing power to the various ingredients of the theory is also investigated, and the importance of the inclusion of target-nucleon correlations (in the second-order Kerman-McManus-Thaler potential) for proper explanation of the data is discussed.

29462 **Zero-crossing angle in the np analyzing power at medium energies and its relation to charge symmetry.** Bhatia, T.S.; Glass, G.; Hiebert, J.C.; Northcliffe, L.C.; Tippens, W.B.; Bonner, B.E.; Simmons, J.E.; Hollas, C.L.; Newsom, C.R.; Riley, P.J.; Ransome, R.D. (Texas A&M University, College Station, Texas 77843). *Physical Review* [*Section*] *C: Nuclear Physics ;* **24**: No. 2, 796-798(Aug 1981).

The angle at which the analyzing power for free np scattering becomes zero, the zero-crossing angle θ_0, has been measured simultaneously for the np and np scattering processes at 425, 565, and 665 MeV incident neutron energies. A rather strong energy dependence of the zero-crossing angle is found. Knowledge of this energy dependence is important in designing an experiment which tests for charge symmetry breaking forces by comparing high precision measurements of θ_0(np) and θ_0(np).

29463 **Experimental test of the Drell-Yan model in p+W→$\mu^+ + \mu^-$ +X.** Smith, S.R.; Childress, S.; Mockett, P.M.; Rutherfoord, J.P.; Williams, R.W.; Gustafson, H.R.; Jones, L.W.; Longo, M.J.; Roberts, T.J.; Whalley, M.R.; Garelick, D.A.; Gauthier, P.S.; Glaubman, M.J.; Johnstad, H.; Mallary, M.L.; Moromisato, J.; Pothier, E.; von Goeler, E.; Oliver, W.P. (University of Washington, Seattle, Washington 98195). *Physical Review Letters ;* **46**: No. 25, 1607-1610(22 Jun 1981).

We report a high-statistics study of the reaction p+W→$\mu^+ + \mu^-$ +X with use of an intense 400-GeV/c proton beam, a magnetized-iron beam dump, and a wide-acceptance detector. Using data near x/sub F/ = 0, we have extracted the nucleon sea-quark distribution and find it to be a factor 1.6 +- 0.3 larger than that obtained by inelastic charged-current neutrino scattering. We then compare the Drell-Yan prediction with our data including the previously unexplored region of large x/sub F/ and find excellent agreement for a wide range of μ-pair invariant mass.

29464 **Observation of prompt like-sign dimuon production in neutrino reactions.** Nishikawa, K.; Buchholz, D.; Barish, B.C.; Bartlett, J.F.; Blair, R.; Chu, Y.; Lee, J.; Linsay, P.; Ludwig, J.; Messner, R.; Mine, P.; Sciulli, F.J.; Shaevitz, M.; Siskind, E.; Edwards, D.; Edwards, H.; Fisk, H.E.; Fukushima, Y.; Krafczyk, G.; Nease, D.; Bodek, A.; Marsh, W.; Fackler, O. (Northwestern University, Evanston, Illinois 60201). *Physical Review Letters ;* **46**: No. 24, 1555-1559(15 Jun 1981).

We report on the observation of 12 like-sign ($\mu^-\mu^-$) neutrino-induced dimuon events with muon momenta greater than 9 GeV. The background from π and K decay is 1.3 events so that we conclude that this prompt signal is real with a significance greater than 1 in 10^7. Although the overall rate is higher than present theoretical estimates, the kinematic distributions of these events are qualitatively consistent with a picture of charm-anticharm production. The ratio of $\mu^-\mu^-/\mu^-$ shows a strong energy dependence and rises to (2.5 +- 1.0) x 10^{-3} at E/sub ν/ = 250 GeV.

29465 **Meson structure functions and A-dependence in single particle inclusive hadron fragmentation.** Garbincius, P.H. *AIP (American Institute of Physics) Conference Proceedings ;* **68**: No. 1, 74-76(Feb 1981). (CONF-800724—).

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

Low p/sub T/ hadronic fragmentation data obtained with the Fermilab Single Arm Spectrometer were used in a recombination model determination of pion and kaon structure functions. Similar data for nuclear targets was used to study the A-dependence of leading particle and fragmentation reactions.

29466 **Hadronic decays of the eta/sub c/.** Crystal Bal Collaboration. (Stanford Linear Accelerator Center). DE-AC03-76SF00515 (SLAC). *AIP (American Institute of Physics) Conference Proceedings ;* **68**: No. 1, 675-678(Feb 1981). (CONF-800724—).

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

Results on hadronic decays of the eta/sub c/ candidate state are presented. A mass value of M = (2978 +- 9) MeV is obtained. The branching fraction for the decay into eta$\pi^+\pi^-$ is presented and an upper limit for the decay into $\pi^0 K^+ K^-$ is given.

29467 **Evidence for gluon radiation in high energy neutrino interactions.** Berkeley, Fermilab, Hawaii, Seattle, Wisconsin Collaboration. *AIP (American Institute of Physics) Conference Proceedings ;* **68**: No. 1, 752-754(Feb 1981). (CONF-800724—).

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

High energy νn interactions in the Fermilab 15-Foot bubble chamber are studied. (AIP)

29468 **New results on polarized electron-proton scattering at SLAC.** Bern-Bielefeld-KEK-Kyoto-Peking-Saclay-SLCA-Tsukuba-Yale Collab. *AIP (American Institute of Physics) Conference Proceedings ;* **68**: No. 1, 781-783(Feb 1981). (CONF-800724—).

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

Further measurements have been made at SLAC of the asymmetry in deep inelastic and resonance region scattering of longitudinally polarized electrons by longitudinally polarized protons. Preliminary results are reported for deep inelastic data in the kinematic range $0.2<x<0.65$ and $3.5<Q^2<10.0$ GeV^2. Final results are presented on resonance region data at $Q^2 = 0.5$ and 1.5 GeV^2.

29469 **Polarization of low mass dimuons produced in hadronic interactions.** Youngquist, R.; LeBritton, J.; McCal, D.; Metcalf, W.J.; Melissinos, A.C. (Rochester Univ., NY (USA). Dept. of Physics and Astronomy); Alspector, J.; Borenstein, S.; Kalbfleisch, G.R.; Strand, R.C. (Brookhaven National Lab., Upton, NY (USA)); Abashian, A. (National Science Foundation, Washington, DC (USA)). *Physics Letters,* [*Section*] *B ;* **95**: No. 3/4, 457-460(Oct 1980).

We have examined the angular distribution of massive $\mu^+\mu^-$ pairs produced in 22 GeV/cπ^-Cu interactions. We find that the

virtual photons which give rise to the process γsub(v) → μ + μ- are mainly longitudinally polarized. This contradicts the simple quark-antiquark annihilation model indicating that this is not the dominant production mechanism for the bulk of the data. However, for large momentum of the incident anti q, better agreement with the q anti q annihilation hypothesis is obtained.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 29490

29470 **(CONF-810368—3) Detection and study of new heavy particles through jet identification.** Babcock, J.B. (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). 1981. Contract AC02-76ER03066. 17p. (COO—3066-169). NTIS, PC A02/MF A01. Order Number DE81025151.

From Conference on perturbative quantum chromodynamics; Tallahassee, FL, USA (25 Mar 1981).

A solution to the problem of the identification of an arbitrary number of jets in high energy collisions is reviewed. Some of the applications of this solution to the study of the electroweak interactions are illustrated through two examples: the detection and analysis of top quarks, and the detection of charged Higgs or pseudo Goldstone bosons, in e^+e^- reactions. Although these two examples involve e^+e^- initial states, the jet identification method described in this paper could be used in the analysis of any reaction involving jets.

29471 **(DOE/ER/03533—192) Majorana neutrinos and magnetic fields.** Schechter, J.; Valle, J.W.F. (Syracuse Univ., NY (USA). Dept. of Physics). Apr 1981. Contract AS02-76ER03533. 24p. (COO—3533-192; SU—4217-192). NTIS, PC A02/MF A01. Order Number DE81026339.

It is stressed that if neutrinos are massive they are probably of Majorana type. This implies that their magnetic moment form factor vanishes identically so that the previously discussed phenomenon of spin rotation in a magnetic field would not appear to take place. It is pointed out that Majorana neutrinos can, however, have transition moments. This enables an inhomogeneous magnetic field to rotate both spin and flavor of a neutrino. In this case the spin rotation changes particle to anti-particle. The spin-flavor rotation effect is worked out in detail. The parameterization and calculation of the electromagnetic form factors of Majorana neutrinos are discussed, taking into account the somewhat unusual quantum theory of massive Majorana particles.

29472 **(DOE/ER/13065—T3) Decay constants of pseudoscalar mesons containing heavy quarks.** Mathur, V.S.; Yamawaki, M.T. (Rochester Univ., NY (USA). Dept. of Physics and Astronomy). 1981. Contract AC02-76ER13065. 14p. (COO—3065-301; UR—785). NTIS, PC A02/MF A01. Order Number DE81025553.

The QCD sum-rules of Shifman et al. for n-th order moments are applied to the determination of the decay constants of pseudoscalar mesons containing a heavy quark (c or b). The general case when Q^2, the squared momentum transfer, is non-zero is considered. The stability of the sum-rules against variations in both Q^2 and n is discussed.

29473 **Nucleon-nucleon dynamics at medium energies. Pt. 1. Unitary model for elastic and inelastic scattering.** Kloet, W.M. (Rutgers - the State Univ., New Brunswick, NJ (USA). Dept. of Physics and Astronomy); Silbar, R.R. (Los Alamos Scientific Lab., NM (USA). Theoretical Div.). *Nuclear Physics [Section] A ;* **338**: No. 2, 281-316(Apr 1980).

A framework is presented for a unified theory of elastic nucleon-nucleon scattering and single-pion production at medium energies. The model is relativistic, unitary, and takes into account all spin complications. In the simplest version of the theory the driving mechanism is one-pion exchange but the model can be extended to include short-range forces. The resulting set of coupled linear integral equations have the structure of three-body equations and can be solved exactly. The method of solution is discussed.

29474 **Quark and lepton masses from renormalization-group fixed points.** Hill, C.T. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Physical Review [Section] D: Particles and Fields ;* **24**: No. 3, 691-703(1 Aug 1981).

The renormalization-group equations describing the evolution of fermion—Higgs-boson Yukawa coupling constants down from M/sub X/ in a grand unified theory possess fixed points which may lead to universal predictions for fermion masses independent of symmetry considerations at M/sub X/. Our analysis predicts roughly-equal240 GeV for the fixed-point t-quark mass. Alternatively, a sufficiently heavy fourth SU(5) generation cannot be ruled out by existing bounds on the number of fermion generations, n/sub f/, and we find fixed-point mass predictions of m/sub T/ roughly-equal219 GeV, m/sub B/roughly-equal215 GeV, and m/sub E/roughly-equal60 GeV.

29475 **Grand unification and parity restoration at low energies. Phenomenology.** Rizzo, T.G.; Senjanovic, G. (Brookhaven National Laboratory, Upton, Long Island, New York 11973). DE-AC02-76CH00016. *Physical Review [Section] D: Particles and Fields ;* **24**: No. 3, 704-718(1 Aug 1981).

Recently, we have shown that simple grand unified theories, such as SO(10), allow the possibility of low-energy parity restoration. In this paper a detailed phenomenological analysis of the left-right-symmetric model is presented. It turns out that the theory passes all the charged- and neutral-current tests for M/sub W/R as low as 100 —300 GeV, if simultaneously $\sin^2\theta$/sub W/≃0.25—0.31. We also estimate masses, widths, and branching ratios for the gauge bosons, as well as their production rates in pp and p-barp reactions.

29476 **Signal for bottom-baryon production in electron-positron colliding beams.** Fajfer, S.; Oakes, R.J. (Institute of Physics, University of Sarajevo, 71000 Sarajevo, Yugoslavia). *Physical Review [Section] D: Particles and Fields ;* **24**: No. 3, 781-783(1 Aug 1981).

The expected contribution to the inclusive proton yield in electron-positron annihilation near the bottom-baryon production threshold is estimated. A plausible model for the production of heavy-quark hadronic states, which adequately describes the observed charmed-baryon production, is assumed. Near threshold bottom-baryon production causes a step in R/sub p/+p-bar of approximately 0.1 to 0.3, which apppears to be a feasible signal to search for at the Cornell Electron Storage Ring.

29477 **Understanding inclusive $pp \to ph^{+-}X$ data with parton fragmentation and structure functions.** Ng, A.; Lassila, K.E.; Sukhatme, U.P. (Ames Laboratory: Department of Energy and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] D: Particles and Fields ;* **24**: No. 3, 784-787(1 Aug 1981).

A model incorporating measured parton fragmentation and structure functions is shown to be in striking agreement with recent inclusive CERN ISR data on charged hadrons produced in $pp \to ph^{+-}X$ in the same hemisphere as the leading proton. These hadrons have low transverse momentum and the momentum of the leading proton is measured. The model is a realization at the parton level of the dual-topological-unitarization scheme for hadron-hadron collisions. Our work supports the attractive idea of universality of jets in both low-p/sub T/ and "hard" processes.

29478 **M/sub W/ = M/sub Z/cosθ/sub W/ in SU(5).** Tsao, H. (Rockefeller University, New York, New York 10021). DE-AC02-76ER02232-B000. *Physical Review [Section] D: Particles and Fields ;* **24**: No. 3, 791-792(1 Aug 1981).

M/sub W/ = M/sub Z/cosθ/sub W/ is a natural relation in the Georgi-Glashow SU(5) model with 75, 5, and 45 Higgs bosons.

29479 **Singular-perturbation—strong-coupling field theory and the moments problem.** Handy, C.R. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Physical Review [Section] D: Particles and Fields ;* **24**: No. 2, 378-383(15 Jul 1981).

Motivated by recent work of Bender, Cooper, Guralnik, Mjolsness, Rose, and Sharp, a new technique is presented for solving field equations in terms of singular-perturbation—strong-coupling expansions. Two traditional mathematical tools are combined into one effective procedure. Firstly, high-temperature lattice expansions are obtained for the corresponding power moments of the field solution. The approximate continuum-limit power moments are subsequently obtained through the application of Pade techniques. Secondly, in order to reconstruct the corresponding approximate global field solution, one must use function-moments reconstruction techniques. The latter involves reconsidering the traditional "moments problem" of interest to pure and applied mathematicians. The above marriage between lattice methods and moments reconstruction procedures for functions yields good results for the phi^4 field-theory kink, and the sine-Gordon kink solutions. It is argued that the power moments are the most efficient dynamical variables for the generation of strong-coupling expansions. Indeed, a momentum-space formulation is being advocated in which the long-range behavior of the space-dependent fields are determined by the small-momentum, infrared, domain.

29480 **Coherent meson-pair states.** Bolsterli, M. (T Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *D: Particles and Fields ;* **24**: No. 2, 400-405(15 Jul 1981).

It is shown that the use of coherent meson-pair states simplifies and improves calculations in static-source theories with complicated algebras.

29481 **Bose-Einstein condensation, spontaneous symmetry breaking, and gauge theories.** Kapusta, J.I. (Theoretical Division, Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *D: Particles and Fields ;* **24**: No. 2, 426-439(15 Jul 1981).

Bosonic chemical potentials for a variety of relativistic field theories are introduced via the methods of functional integrals with the aim of studying the relationship between Bose-Einstein condensation and spontaneous symmetry breaking. The models studied include the noninteracting and the self-interacting charged scalar field, scalar electrodynamics and the Higgs model, and the Weinberg-Salam model. In general the chemical potential acts as an effective symmetry-breaking parameter although the phase diagrams for the two cases ($m^2<0$ and $m^2>0$) look very different. It is found that the symmetry-restoring temperature in the Weinberg-Salam model increases with increasing electric charge density. Finally, the analysis of Jakobsen, Kon, and Segal of a conserved isotropic total angular momentum for the cosmic background radiation is shown to be erroneous.

29482 **Natural gauge model allowing all weak bosons above the standard W and Z.** Barger, V.; Ma, E.; Whisnant, K. (Physics Department, University of Wisconsin, Madison, Wisconsin 53706). DE-AC02-76ER00881-200. *Physical Review Letters ;* **46**: No. 23, 1501-1503(8 Jun 1981).

We construct a natural SU(2)xU(1)x[SU(2)'] gauge model in which the lightest weak bosons can be heavier than those of the standard model. At energies below the Z boson, the model could be distinguished from the standard model by precision measurements of $e^+e^-\rightarrow\mu^+\mu^-$.

29483 **Parameters of the six-quark model.** Gaiser, B.D.; Tsao, T.; Wise, M.B. (Institute of Theoretical Physics, Department of Physics, Stanford University, Stanford, California 94305). *Annals of Physics (New York) ;* **132**: No. 1, 66-86(Mar 1981).

The restrictions imposed on the parameters of the six-quark model by the neutral kaon system are discussed with QCD effects included in the leading logarithmic approximation. The dependence on the six-quark model parameters of the sign and magnitude of the CP violation parameter ϵ', the b-quark lifetime and the ratio of decay widths $\Gamma(b\rightarrow uX)/\Gamma(b\rightarrow cX)$ are also discussed.

29484 **Magnitude of the parton intrinsic transverse momentum.** Metcalf, W.J.; Aitchison, I.J.R.; LeBritton, J.; McCal, D.; Melissinos, A.C. (Rochester Univ., NY (USA). Dept. of Physics and Astronomy); Contogouris, A.P.; Papadopoulos, S. (McGill Univ., Montreal, Quebec (Canada). Dept. of Physics); Alspector, J.; Borenstein, S.; Kalbfleisch, G.R. (Brookhaven National Lab., Upton, NY (USA)). *Physics Letters,* [*Section*] *B ;* **91**: No. 2, 275-280(Apr 1980).

We analyze data on the transverse momentum distribution of dimuons produced by 22 GeV and 16 GeV π^- incident on a Cu target. We evaluate the quantum chromodynamic lowest order perturbation contributions and also introduce an intrinsic transverse momentum k/sub T/ on the partons relative to their parent hadrons. The analysis of our data leads to [k/sub T/] = 0.30-0.35 GeV. We discuss our result in comparison with analyses of data at higher energies.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 29482, 29483

29485 **Isospin breaking in technicolor models.** Sikivie, P. (Stanford Linear Accelerator Center, CA (USA)); Susskind, L. (Stanford Univ., CA (USA). Dept. of Physics); Voloshal, M.; Zakharov, V. (Moskovskij Inst. Theoreticheskoj i Ehksperimental'noj Fiziki (USSR)). *Nuclear Physics* [*Section*] *B ;* **173**: No. 2, 189-207(Oct 1980).

Recent attempts to construct realistic technicolor (TC) models have raised the problem of how the two following experimental facts, msub(u) is unequal to msub(d), (1.1), and Msub(W) = Msub(Z)cosTHETAsub(w)(1 +- a few percent), (1.2), can be made compatible. Equation (1.1) is a clear violation of isospin, but isospin conservation (+- a few percent) would imply equation (1.2). Indeed, equation (1.2) follows from electric charge conservation plus the conservation (+- a few percent) of a SU(2), e.g., the isospin group, under which the generators of SU(2)sub(L) transform as a triplet. In technicolor models, it is necessary to obtain equation (1.2) not only 'at the tree level' but to all orders of the technicolor interactions since these are strong. This is then most efficiently done by requiring that the technicolor interactions conserve (before and after dynamical symmetry breakdown) a SU(2) flavor symmetry group.

6454 Field Theory

REFER ALSO TO CITATION(S) 29382, 29467, 29479, 29481, 29582

29486 **(DOE/ER/03533—191) On the construction of exact multi-monopole solutions in Yang-Mills-Higgs system.** Narain, K.S. (Syracuse Univ., NY (USA). Dept. of Physics). Mar 1980. Contract AS02-76ER03533. 17p. (COO—3533-191; SU—4217-191). NTIS, PC A02/MF A01. Order Number DE81026532.

Recently exact axially symmetric multi-monopole solutions in Yang-Mills-Higgs system were constructed by Prasad et al in the Prasad-Sommerfield limit. In the present paper their results are expressed in a more convenient and closed form with general constraint relations given on the parameters in order to ensure reality of the solution over all space. Further it is shown that solutions satisfying reality condition, although regular on the x_3 axis in general, develop singularities on the asymptotic surfaces near the x_3 axis. The necessary and sufficient conditions to ensure non-singularity of the solutions on the asymptotic surfaces and hence the finiteness of energy are given. The solution to these conditions uniquely determines all the parameters, up to an overall translation, and are the ones that appear in Prasad's Ansatz.

29487 **(LBL—12826) Petite unification: an alternative viewpoint.** Hung, P.Q. (Lawrence Berkeley Lab., CA (USA)). May 1981. Contract W-7405-ENG-48. 11p. (CONF-810485—2). NTIS, PC A02/MF A01. Order Number DE81025680.

From 2. workshop on grand unification; Ann Arbor, MI, USA (Apr 1981).

It is assumed that at some distance scale, not too many orders of magnitude less than the compton wavelength of intermediate bosons W^{+-} and Z^0, the SU(3)/sub c/ x SU(2)/sub L/ x U(1)/sub Y/ gauge theory, characterized by three coupling constants, becomes embedded in a gauge theory G/sub S/ x G/sub W/ characterized by only two coupling constants, g/sub S/ and g/sub W/. The strong group G/sub S/ and weak group G/sub W/ are assumed each to be either simple or pseudo-simple i.e. a direct product of simple groups with identical coupling strengths. Such a possibility is caled petite unification. Any subsequent unification of the strong force with the weak at still shorter distances is left unconsidered. A building-up procedure is adopted, that is to say the available inputs from the low-energy theory SU(3)/sub c/ x SU(2)/sub L/ x U(1)/sub Y/ are used to restrict the choices of G/sub S/ and G/sub W/. The inputs used are the experimental value of $\sin^2\theta$/sub W/ and the known fermion representations. The choices of G/sub W/ are found to be quite restricted. The smallest acceptable G/sub W/ turns out to be $[SU(2)]^4$, and the most efficient choice of a strong group is SU(4) built a la Pati and Salam, which is the simplest case for which the electroweak U(1)/sub Y/ generator is a linear combination of both G/sub S/ and G/sub W/ generators. Furthermore, leptons provide the fourth color degree of freedom achieving thus an early quark-lepton unification. The phenomenology of the minimal petite unification model SU(4) x $[SU(2)]^4$ is examined in detail.

29488 **(LBL—12852) Classical field theory with Z(3) symmetry.** Ruck, H.M. (Lawrence Berkeley Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 9p. (CONF-810385—2). NTIS, PC A02/MF A01. Order Number DE81027089.

From Conference on non-linear problems: present and future; Los Alamos, NM, USA (Mar 1981).

Solutions and some of their properties of a classical vector field model in two-dimensional Minkowski space with internal symmetry Z(3) - the cyclic group of order three are presented.

29489 **(SLAC—240) Long-range interactions in lattice field theory.** Rabin, J.M. (Stanford Linear Accelerator Center, CA (USA)). Jun 1981. Contract AC03-76SF00515. 140p. NTIS, PC A07/MF A01. Order Number DE81027236.

Lattice quantum field theories containing fermions can be formulated in a chirally invariant way provided long-range interactions are introduced. It is established that in weak-coupling perturbation theory such a lattice theory is renormalizable when the corresponding continuum theory is, and that the continuum theory is indeed recovered in the perturbative continuum limit. In the strong-coupling limit of these theories one is led to study an effective Hamiltonian describing a Heisenberg antiferromagnet with long-range interactions. Block-spin renormalization group methods are used to find a critical rate of falloff of the interactions, approximately as inverse distance squared, which separates a nearest-neighbor-antiferromagnetic phase from a phase displaying identifiable long-range effects. A duality-type symmetry is present in some block-spin calculations.

29490 **Bag boundary conditions for confinement in the qq-bar relative coordinate.** Haymaker, R.W.; Goldman, T. (Department of Physics and Astronomy, Louisiana State University, Baton Rouge, Louisiana 70803). *Physical Review [Section] D: Particles and Fields ;* **24**: No. 3, 743-751(1 Aug 1981).

A procedure for finding baglike confining boundary conditions in relative coordinates for noninteracting two-particle states is described and explicity developed for the case of a fermion-antifermion pair. As an example, the resulting conditions are applied to find the spectrum of low-lying meson states.

29491 **Nature of the phase transition in compact QED.** Bhanot, G. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). DE-AC02-76CH00016. *Physical Review [Section] D: Particles and Fields ;* **24**: No. 2, 461-465(15 Jul 1981).

The four-dimensional O(2) gauge theory is studied by computer simulations and its phase structure is investigated by three methods: (i) by accurately measuring the action per plaquette on a 12^4 lattice, (ii) through a scaling analysis of a certain function of Wilson loops, and (iii) via its string tension. All these methods consistently indicate that the theory has a line of fixed points. The end point of this line exhibits a power-law divergence of the correlation length with index $\nu = 0.35 +- 0.05$.

29492 **Phase transition in Yang-Mills theory for θ near π.** Snyderman, N.; Gupta, S. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). DE-AC03-76SF00515. *Physical Review [Section] D: Particles and Fields ;* **24**: No. 2, 542-545(15 Jul 1981).

We infer the existence of a phase transition in pure non-Abelian gauge theories at zero temperature for θ near π. Our analysis assumes that instantons are responsible for the onset of the deviation from perturbative behavior in the theory. We show that this leads to a weak-coupling zero of the β function for θ near π, implying the loss of confinement.

29493 **Phase transition in SU(5) lattice gauge theory.** Creutz, M. (Brookhaven National Laboratory, Upton, New York 11973). DE-AC02-76CH00016. *Physical Review Letters ;* **46**: No. 22, 1441-1443(1 Jun 1981).

Monte Carlo evidence is presented for a first-order phase transition in pure SU(5) lattice gauge theory with Wilson's action in four space-time dimensions. Although less clear, a similar transition is strongly suggested already with SU(4).

29494 **Dimensional analysis in field theory.** Stevenson, P.M. (Physics Department, University of Wisconsin-Madison, Madison, Wisconsin 53706). DE-AC02 76ER00881-144. *Annals of Physics (New York) ;* **132**: No. 2, 383-403(1 Apr 1981).

Dimensional Transmutation (the breakdown of scale invariance in field theories) is reconciled with the commonsense notions of Dimensional Analysis. This makes possible a discussion of the meaning of the Renormalisation Group equations, completely divorced from the technicalities of renormalisation. As illustrations, I describe some very farmiliar QCD results in these terms.

29495 **Continuum QCD_2 from a fixed-point lattice action.** Rossi, P. (Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). DE-AC02076ERO3069. *Annals of Physics (New York) ;* **132**: No. 2, 463-481(1 Apr 1981).

Gauge invariant expectation values for lattice gauge theory with a general local action in two dimensions may be expressed as functions of the single plaquette averages. The value of these averages at the fixed point of the renormalization group can be determined exactly, and the corresponding lattice theory is shown to reproduce the continuum results. The limit N/sub c/ = ∞ is investigated in detail, and fixed point values for all the averages are explicitly determined. Wilson's action results agree only to first order in weak coupling.

29496 **Monopoles and their symmetries.** Manton, N.S. (Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). DE-AC0276ER03069. *Annals of Physics (New York) ;* **132**: No. 1, 108-120(Mar 1981).

Properties of spherically symmetric monopoles are discussed. Inversion symmetry is also considered.

65 PHYSICS RESEARCH

6510 Nuclear Physics

29497 **(JAERI-M—9464) Japanese list of requests for nuclear data.** Igarasi, S. (Japan Atomic Energy Research Inst., Tokyo). Apr 1981. 63p. (INDC(JAP)—58/G; NEANDC(J)—71/AU). NTIS (US Sales Only), PC A04/MF A01. Order Number DE81903804.

A computer listing of Japanese requests for nuclear data submitted to new WRENDA in 1980 is presented. The 165 requests are categorized as fission reactor (63), fusion reactor (61), and safeguards (41). Also, 111 requests which were withdrawn from WRENDA are listed. (WHK)

29498 **(LA—8874-PR) Applied nuclear data research and development. Progress report, January 1-March 31, 1981.** Baxman, C.I.; Young, P.G. (comps.). (Los Alamos National Lab., NM (USA)). Jul 1981. Contract W-7405-ENG-36. 59p. NTIS, PC A04/MF A01. Order Number DE81028587.

Activities of the Los Alamos Nuclear Data Group for January 1 through March 31, 1981, are described. Topics include: (1) peripheral effects in R-matrix theory; (2) Coulomb corrections in light nuclei; (3) new R-matrix analysis of reactions in the ^{7}Li system; (4) variance-covariance analysis of n + Li reactions; (5) calculated charged-particle emission in the mass-90 region; (6) determination of deformed optical model parameters for neutron reactions on ^{235}U and ^{239}Pu; (7) calculation of excited state cross sections for actinide nuclei; (8) calculation of the prompt neutron spectrum and ν/sub p/ for the spontaneous fission of ^{252}Cf; (9) international nuclear model codes comparison study; (10) an improved calculation of heating and radiation damage from neutron capture; (11) LMFBR cross-section production with MAX; (12) TRANSX development; (13) THOR calculations; (14) covariance processing; (15) analysis of charges for use of central computing facility; (16) S/sub n/ calculations for D_2O sphere; (17) integral data testing of ENDF/B fission-product data; (18) decay power comparisons using ENDF/B-IV and -V data in CINDER-10; (19) ENDF/B-V data testing and summary data; (20) SPEC5: code to produce multigroup spectra; and (21) calculation of H. B. Robinson-2 fuel isotopics and comparison with measurements. (WHK)

6511 Experimental Techniques

REFER ALSO TO CITATION(S) 29736

6512 Nuclear Properties And Reactions, A=1-5

REFER ALSO TO CITATION(S) 29547

29499 **Reaction πi +d→p+p at 20 to 65 MeV.** Ritchie, B.G.; Edge, R.D.; Malbrough, D.J.; Preedom, B.M.; Bertrand, F.E.; Gross, E.E.; Obenshain, F.E.; Wu, J.R.; Blecher, M.; Gotow, K.; Burman, R.L.; Carlini, R.; Hamm, M.E.; Leitch, M.J.; Moinester, M.A. (Department of Physics and Astronomy, University of South Carolina, Columbia, South Carolina 29208). *Physical Review [Section] C: Nuclear Physics ;* **24**: No. 2, 552-560(Aug 1981).

Angular distributions for the reaction π^{+} +d→p+p have been measured for pion laboratory energies ranging from 20 to 65 MeV. Uncertainties in the total cross sections were less than 6% at all energies studied. The angle integrated cross sections were determined to be 4.31 +- 0.18, 4.84 +- 0.20, 4.26 +- 0.16, 5.19 +- 0.21, 5.30 +- 0.25, 5.20 +- 0.28, and 7.40 +- 0.30 mb for pion laboratory energies of 20, 25, 30, 35, 40, 45, and 65 MeV, respectively. These values confirmed the general trend observed for the total reaction cross section at energies below resonance. The angular distributions and integrated cross sections are compared with recent microscopic calculations. Though qualitative agreement is evident between the models used to describe the process and experimental results, quantitative agreement is still lacking.

29500 **Configuration space Faddeev calculations. IV. Trinucleon charge density.** Friar, J.L.; Gibson, B.F.; Tomusiak, E.L.; Payne, G.L. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] C: Nuclear Physics ;* **24**: No. 2, 665-676(Aug 1981).

The charge densities of ^{3}H and ^{3}He are computed for several potential models. These densities are further broken down into isospin components and into components from the S, S', and D states. Wave functions for these states are plotted in order to illustrate the structure seen in the densities. Inclusion of nucleon finite size eliminates the fine structure seen in the point nucleon cases. Form factors corresponding to those densities are also calculated. The inclusions of a Coulomb interaction between the two protons in ^{3}He is seen to produce a small but nonnegligible change in the density. The theoretical ^{3}He densities for the Reid Soft Core model are compared to the "experimental" one obtained by fitting the experimental form factor data after having approximately removed the effect of nucleon finite size. The central depression seen in the experimental density is not present in the theoretical ones, and we speculate on this and other discrepancies.

29501 **2^{+} 40 MeV ^{4}He resonance in a 4hω model space.** Bevelacqua, J.J. (United States Department of Energy, Oak Ridge Operations Office, P.O. Box E, Oak Ridge, Tennessee 37830). *Physical Review [Section] C: Nuclear Physics ;* **24**: No. 2, 712-716(Aug 1981).

Dynamical R-matrix methodology is used to determine the properties of the recently proposed J/sup π/ = 2^{+}, Γ = 3.5 MeV, E/sub x/(res) = 40.2 MeV resonance in ^{4}He. The calculations lead to a J/sup π/ = 2^{+} state with the following properties: Γ = 6.0 MeV, E/sub x/(res) = 40.3 MeV, and T = 0. The calculations indicate the importance of 4hω components in the proper description of the 40 MeV state.

29502 **Pion absorption in /sup 3,4/He and πN resonances.** Orphanos, L.; Kaellne, J.; Altemus, R.; Gugelot, P.C.; McCarthy, J.S.; Minehart, R.C.; Gram, P.A.M.; Hoeistad, B.; Morris, C.L.; Wadlinger, E.A.; Perdrisat, C. (University of Virginia, Charlottesville, Virginia 22901). *Physical Review Letters ;* **46**: No. 24, 1562-1565(15 Jun 1981).

The cross sections of /sup 3,4/He(π^{-},n)/sup 2,3/H have been measured at 285, 428, 525, and 575 MeV extending the information on the energy dependence beyond the region previously known (50 —300 MeV). The cross sections beyond the region of the Δ resonance are found to decrease less rapidly than that of the elementary πd→pp process. This energy dependence suggests that pion absorption in a nucleus is associated with π+N (off-shell) scattering which includes I = 1/2 πN resonances that are strongly suppressed in πd→pp.

6513 Nuclear Properties And Reactions, A=6-19

29503 **(DOE/ER/03244—T1) Experimental medium-energy physics. Annual progress report, October 1980-June 1981.** (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). 1981. Contract AS02-76ER03244. 96p. (COO—3244-83). NTIS, PC A05/MF A01. Order Number DE81027245.

Research from October 1980 to June 1981 at Carnegie-Mellon University in experimental nuclear physics is summarized. Studies included: hypernuclei of carbon 13, nitrogen 14, and oxygen 18; momentum space calculations of kaon-nucleus elastic scattering; and pion annihilation in Lithium 7 via ^{7}Li (π,pd) ^{4}He. (GHT)

29504 **(DOE/ER/03244—T2) Elastic and inelastic scattering of 800 MeV/c K^{+-} mesons from ^{12}C and ^{40}Ca.** Marlow, D.R. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Physics). Apr 1981. Contract AS02-76ER03244. 344p. (COO—3244-82). NTIS, PC A15/MF A01. Order Number DE81025962.

Thesis.

Methods and results of an experiment to study the scattering of 800 MeV/c K^{+-} mesons from ^{12}C and ^{40}Ca are presented. The reactions under study include: the four elastic scattering reactions ^{12}C(K^{+-},K^{+-}) and ^{40}Ca(K^{+-},K^{+-}), and the four inelastic scattering reactions, ^{12}C(K^{+-}.K^{+-}') to the J/sup P/ = 2^{+} 4.43 MeV and J/sup P/ = 3^{-} states. The experimental data were obtained using the Hyper-Nuclear Spectrometer and the Low Energy Separated Beam (LESB I) at the Alternating Gradient Synchrotron (AGS) of Brookhaven Laboratory (BNL). Calculations using the program PIRK, an optical potential code, are compared to the elastic data. The results of a second set of calculations, using Glauber theory are also presented. Both sets of calculations use as input: the results of partial wave analyses of kaon nucleon scattering data, and nuclear shapes as determined from the results of electron nucleus scattering experiments. The agreement between the experimental data and the theoretical predictions is reasonable over the angular range of

the data, with the exception of Glauber calculations of the K^+ elastic scattering. In those cases, the eikonal approximation proves to be a poor approximation. Smaller discrepancies are found in some other cases, indicating the possible need for more sophisticated calculations. (WHK)

29505 **^{12}C(p,n)^{12}N reaction at 120, 160, and 200 MeV.** Rapaport, J.; Taddeucci, T.; Gaarde, C.; Goodman, C.D.; Foster, C.C.; Goulding, C.A.; Horen, D.; Sugarbaker, E.; Masterson, T.G.; Lind, D. (Ohio University, Athens, Ohio 45701). *Physical Review [Section] C: Nuclear Physics ;* **24**: No. 2, 335-341(Aug 1981).

Angular distributions for the ground-state ($\Delta J/\sup \pi/ = 1^+$) and 0.96-MeV ($\Delta J/\sup \pi/ = 2^+$) transitions in the ^{12}C(p,n)^{12}N reaction have been measured at incident energies of 120, 160, and 200 MeV. The measured values of the differential cross section align themselves into smooth curves independent of incident energy when converted into plane-wave cross section values and plotted versus momentum transfer. This information supports the hypothesis that the spin-isospin term of the effective interaction is almost energy independent in this energy region. Microscopic distorted-wave impulse approximation calculations are presented.

29506 **(π,πn) puzzle above the (3,3) resonance.** Sternheim, M.M.; Silbar, R.R. (Department of Physics and Astronomy, University of Massachusetts, Amherst, Massachusetts 01003). *Physical Review [Section] C: Nuclear Physics ;* **24**: No. 2, 574-577(Aug 1981).

We calculate the corrections due to pion production, Fermi motion, and the Pauli principle on the ratio of $^{12}C(\pi^+,\pi N)^{11}C$ total cross sections for particle-stable final states. These corrections are important above 400 MeV. When they are combined with those estimated earlier for final state nucleon charge exchange interactions, good agreement is obtained with the data, which cover the energy region from 40 to 550 MeV.

29507 **Identification of $\Delta S = 1$ transitions in ^{13}C by measurement of pion inelastic excitation functions.** Seestrom-Morris, S.J.; Dehnhard, D.; Holtkamp, D.B.; Morris, C.L. (University of Minnesota, Minneapolis, Minnesota 55455). *Physical Review Letters ;* **46**: No. 22, 1447-1450(1 Jun 1981).

Differential cross sections for $^{13}C(\pi,\pi/\sup \text{prime}/)$ were measured between 100 and 300 MeV for momentum transfers of 1.1h fm^{-1} and 1.4h fm^{-1}. In this energy range the different energy dependences of the spin-dependent and spin-independent parts of the pion-nucleon interaction provide a very sensitive method of discriminating between transitions that proceed with a spin transfer ($\Delta S = 1$) or without a spin transfer ($\Delta S = 0$). Five transitions in ^{13}C were found to be dominated by the $\Delta S = 1$ transition density amplitude.

29508 **Experimentally determined thick target yields for the ^{14}N(p,α)^{11}C reaction.** Ruth, T.J.; Bida, G.T.; Wolf, A.P. (Brookhaven National Lab., Upton, NY (USA)). *Journal of Labelled Compounds and Radiopharmaceuticals ;* **18**: No. 1-2, 247-248(Jan-Feb 1981).

From 3. international symposium on radiopharmaceutical chemistry; St. Louis, MO, USA (16 - 20 Jun 1980).

29509 **Influence of particle collisions on the time dependent Hartree-Fock fusion window in ^{16}O + ^{40}Ca.** Wong, C.Y.; Davies, K.T.R. (Oak Ridge National Lab., TN (USA). Physics Div.). *Physics Letters, [Section] B ;* **96**: No. 3/4, 258-260(3 Nov 1980).

We study the collision of ^{16}O and ^{40}Ca in an extended time-dependent Hartree-Fock approximation. The fusion window persists even in the presence of particle collision.

29510 **Magnetic dipole strength in ^{16}O.** Arima, A.; Strottman, D. (Los Alamos Scientific Lab., NM (USA). Theoretical Div.). *Physics Letters, [Section] B ;* **96**: No. 1/2, 23-25(20 Oct 1980).

The strength of magnetic dipole excitation from the ^{16}O ground state is calculated. One anticipates a relatively large amount of the M1 strength between 16 MeV and 18 MeV which is about one third of that of the 15.1 MeV, 1^+ state in ^{12}C.

29511 **Precise γ-ray energies from the ^{14}N(n,γ)^{15}N and ^{23}Na(n,γ)^{24}Na reactions.** Greenwood, R.C. (Idaho National Engineering Lab., Idaho Falls (USA)); Chrien, R.E. *Nuclear Instruments and Methods ;* **175**: No. 2/3, 515-519(15 Sep 1980).

Precise values for the energies of the γ rays emitted in the ^{14}N(n,γ) reaction with slow neutrons have been obtained from spectral measurements using Ge semiconductor detectors. The approach which was used in the analysis of the data involved normalization of the ^{14}N(n,γ) reaction γ-ray energies to the most recent value for the neutron binding energy of ^{15}N[Ssub(n)(^{15}N) = (10833.297 +- 0.038) keV]. This was accomplished through measurement of energy differences between the 5.2 and 5.5 MeV cascade γ rays, followed by general energy fitting procedures to obtain other γ-ray energies. With this approach, ^{14}N(n,γ) reaction γ-ray energies with measurement uncertainties as small as 6 ppm were obtained. Selected energies of γ rays emitted in the ^{23}Na(n,γ) reaction were obtained from spectra measured with mixed N and Na targets. From these data, based upon cascade sums, we obtain a value of Ssub(n)(^{24}Na) = (6959.426 +- 0.076) keV.

6514 Nuclear Properties And Reactions, A=20-38

REFER ALSO TO CITATION(S) 29511, 29517, 29519

29512 **(LA-UR—81-1755) Thermal neutron absorption cross section of sulfur and the 252-californium nubar problem.** Jurney, E.T.; Raman, S.; Spencer, R.R. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 5p. (CONF-810920—3). NTIS, PC A02/MF A01. Order Number DE81025413.

From 4. international symposium on neutron-capture gamma-ray spectroscopy and related topics; Grenoble, France (7 Sep 1981).

The thermal neutron absorption cross section for natural sulfur was measured to be 513 +- 15 mb. Any discrepancy between $MnSO_4$-bath and liquid scintillator measurements of ^{252}Cf(anti ν) cannot be attributed to a discrepancy in this cross section value.

29513 **(LA-UR—81-1795) Direct capture in the ^{34}S(n,γ)^{35}S reaction with thermal neutrons.** Carleton, R.F.; Raman, S.; Jurney, E.T. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 3p. (CONF-810920—5). NTIS, PC A02/MF A01. Order Number DE81025300.

From 4. international symposium on neutron-capture gamma-ray spectroscopy and related topics; Grenoble, France (7 Sep 1981).

The partial capture cross sections for primary γ rays in the ^{34}S(n,γ)^{35}S reaction with thermal neutrons are in reasonable agreement with the direct capture predictions of Lane and Lynn.

29514 **(LA-UR—81-1796) ^{36}S(n,γ)^{37}S reaction with thermal neutrons.** Raman, S.; Ratynski, W.; Jurney, E.T. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 3p. (CONF-810920—4). NTIS, PC A02/MF A01. Order Number DE81025301.

From 4. international symposium on neutron-capture gamma-ray spectroscopy and related topics; Grenoble, France (7 Sep 1981).

The ^{36}S(n,γ)^{37}S reaction has been studied for the first time. Four primary transitions account for >95% of the thermal neutron capture cross section of 230 +- 20 mb.

29515 **Resonant heavy-ion elastic scattering from s-d shell nuclei.** De Vries, R.M. (Los Alamos Scientific Lab., NM (USA)). *Nukleonika ;* **24**: No. 1-2, 75-85(1979).

From 9. Summer school of nuclear physics; Mikolajki, Poland (20 Aug - 10 Sep 1978).

Angular distributions at angles $130^0 <$ thetasub(cm) $< 180^0$ have been measured for ^{12}C + ^{28}Si, ^{32}S, ^{40}Ca as well as ^{9}Be, ^{13}C + ^{28}Si in the energy range 20 MeV $<=$ Esub(cm) $<=$ 35 MeV. Cross sections rising towards 180^0 are observed for all reactions. Excitation functions for the back-angle enhancement show distinct structure, most pronounced for ^{12}C+ ^{28}Si. Angular distributions for

^{12}C, especially those corresponding to peaks in the excitation function, show oscillations of the type ' Psub(J)(costheta)'^{2} The ^{12}C back-angle enhancement decreases with target mass. Backscattering of the non-alpha nuclei ^9Be and ^{13}C is reduced by about two orders of magnitude in comparison with ^{12}C. Similar measurements for the ^{28}Si (^{12}C, ^{16}O)^{24}Mg reaction and ^{16}O + ^{24}Mg elastic scattering allow comparison of reaction data with the corresponding entrance and exit channel data. Standard theoretical approaches fail to explain all the observed effects.

29516 High-energy, heavy-ion elastic scattering. De Vries, R.M. (Los Alamos Scientific Lab., NM (USA)). *Nukleonika ;* **24**: No. 1-2, 87-94(1979).

From 9. Summer school of nuclear physics; Mikolajki, Poland (20 Aug - 10 Sep 1978).

Measurements of heavy-ion elastic scattering at the highest available bombarding energies (Esub(i)>=15 MeV/A) have revealed considerable information about the heavy-ion-nucleons interaction. In particular a pronounced transition of scattering characteristics is observed between light-ions (A<=6) and heavy-ions (A>=12).

6515 Nuclear Properties And Reactions, A=39-58

REFER ALSO TO CITATION(S) 29509

29517 (UCRL—86443) Three recent TDHF calculations. Weiss, M.S. (Lawrence Livermore National Lab., CA (USA)). May 1981. Contract W-7405-ENG-48. 19p. (CONF-810563—3). NTIS, PC A02/MF A01. Order Number DE81026801.

From Adriatic europhysics study on nuclear physics dynamics of heavy-ion collisions conference; Croatis, Yugoslavia (25 May 1981).

Three applications of TDHF are discussed. First, vibrational spectra of a post grazing collision ^{40}Ca nucleus is examined and found to contain many high energy components, qualitatively consistent with recent Orsay experiments. Second, the fusion cross section in energy and angular momentum are calculated for ^{16}O + ^{24}Mg to exhibit the parameters of the low l window for this system. A sensitivity of the fusion cross section to the effective two body potential is discussed. Last, a preliminary analysis of ^{86}Kr + ^{139}La at E/sub lab/ = 505 MeV calculated in the frozen approximation is displayed, compared to experiment and discussed.

29518 Pion inelastic scattering to the low-lying states in /sup 42,44,48/Ca: Determination of the neutron and proton multipole matrix elements. Boyer, K.G.; Cottingame, W.B.; Smith, L.E.; Greene, S.J.; Moore, C.F.; McCarthy, J.S.; Minehart, R.C.; Davis, J.F.; Burleson, G.R.; Blanpied, G.; Goulding, C.A.; Thiessen, H.A.; Morris, C.L. (University of Texas at Austin, Austin, Texas 78712). *Physical Review [Section] C: Nuclear Physics ;* **24**: No. 2, 598-604(Aug 1981).

A distorted-wave impulse-approximation analysis of 180-MeV π^{+-} inelastic-scattering data to the 2^+_1 and 3^-_1 states in /sup 42,44,48/Ca is used to extract the neutron and proton (alternatively, isovector and isoscalar) multipole matrix elements for exciting these states. Model-dependent errors are examined by comparing results of calculations using collective-model form factors with those using form factors fitted to electron inelastic-scattering data.

6516 Nuclear Properties And Reactions, A=59-89

REFER ALSO TO CITATION(S) 29523

29519 (LBL—12656) Experiments with relativistic heavy ions: a potpourri of chemistry, Canis Majoris and grains of silver. Heckman, H.H. (Lawrence Berkeley Lab., CA (USA)). 1981. Contract W-7405-ENG-48. 21p. (CONF-810563—2). NTIS, PC A02/MF A01. Order Number DE81025215.

From Adriatic europhysics study on nuclear physics dynamics of heavy-ion collisions conference; Croatis, Yugoslavia (25 May 1981).

A selection of three experimental programs, unique in their applied techniques and physics objectives, form the basis of a review of contemporary experiments in relativistic heavy ion physics.

29520 Survey of experimental tests of the IBA model. Casten, R.F. (Brookhaven National Lab., Upton, NY (USA)). *Nuclear Physics [Section] A ;* **347**: No. 1/2, 173-204(Sep 1980).

A survey of experimental tests of the Interacting Boson Approximation (IBA) Model is presented covering even and odd mass nuclei in the region from A approx. 80 to A approx. 230. Both positive and negative parity states with both high and low spin are discussed. Topics included concern energy levels, electromagnetic transition rates, two nucleon transfer, and inelastic scattering. Special attention is given to nuclear symmetries and transitional regions. Comparison with other models is made where appropriate. The distinction between IBA-1 and IBA-2 is discussed including their respective areas of applicability.

6517 Nuclear Properties And Reactions, A=90-149

REFER ALSO TO CITATION(S) 28693, 28693, 29517

29521 (BNL—29691) Levels in ^{146}Ce and the N = 88 isotones. Gowdy, G.M.; Chrien, R.E.; Chu, Y.Y. (Brookhaven National Lab., Upton, NY (USA); Ames Lab., IA (USA)). 1981. Contract AC02-76CH00016. 7p. (CONF-810649—10). NTIS, PC A02/MF A01. Order Number DE81027316.

From 4. international conference on nuclei far from stability; Helsignor, Denmark (7 Jun 1981).

An investigation of the level structure of ^{146}Ce following the beta decay of the low-spin isomer of ^{146}La has been carried out at the ISOL facility TRISTAN at Brookhaven National Laboratory. The half-life for the low spin isomer was found to be 6.0 +- 0.4s. A partial level scheme for ^{146}Ce below 2 MeV is given. The level energies and some B(E2) values extracted from our data have been compared with IBA-2 calculations done entirely with extrapolated parameters from neighboring Z nuclei in order to check the predictive power of the model. Systematics of the Z = 58 isotopes and N = 88 isotones indicate that although ^{146}Ce is more deformed than its isotones with Z ≧ 60, the transition to the well-deformed region can probably more correctly be thought to occur after ^{146}Ce, between N = 88 and N = 90, as it does for Z ≧ 60. The abrupt onset of deformation present in the higher Z isotopes is not seen in the Ce isotopes where the trend is found to be rather smooth throughout.

29522 (BNL—29692) Nuclear spectroscopy of neutron rich A = 147 nuclides: decay of ^{147}Cs, ^{147}Ba and ^{147}La. Shmid, M.; Chu, Y.Y.; Gowdy, G.M. (Brookhaven National Lab., Upton, NY (USA); Oklahoma Univ., Norman (USA)). 1981. Contract AC02-76CH00016. 5p. (CONF-810649—11). NTIS, PC A02/MF A01. Order Number DE81027315.

From 4. international conference on nuclei far from stability; Helsignor, Denmark (7 Jun 1981).

A study of the beta decay of neutron rich nuclides of the A = 147 chain was carried out at the TRISTAN isotope separator. Half lives of ^{147}Cs, ^{147}Ba and ^{147}La were measured. Six gamma lines are assigned to ^{147}Cs decay. A decay scheme for ^{147}Ba with levels up to 2 MeV is proposed for the first time. A partial decay scheme for ^{147}La is proposed, which confirms the previously existing one, with five new levels added from the present work.

29523 (BNL—29693) Precision Q-value determinations for neutron-rich rubidium isotopes at TRISTAN. Brenner, D.S.; Martel, M.K.; Aprahamian, A. (Brookhaven National Lab., Upton, NY (USA); Clark Univ., Worcester, MA (USA)). 1981. Contract AC02-76CH00016. 5p. (CONF-810649—12). NTIS, PC A02/MF A01. Order Number DE81027334.

From 4. international conference on nuclei far from stability; Helsignor, Denmark (7 Jun 1981).

Beta-ray end-point energies for Rb fission products were measured at the TRISTAN on-line mass separator using an intrinsic Ge β spectrometer. Coincidence measurements were used to establish feeding relationships and to verify level schemes in daughter

nuclides. Q/sub β/ values are reported for ^{88,94,96,98}Rb and compared with results from other experiments and with predictions of mass formulae.

29524 **(BNL—29694) Band structure in ^{148}Ce from the decay of mass-separated ^{148}La.** Gill, R.L.; Brenner, D.S.; Wohn, F.K.; Chung, C. (Brookhaven National Lab., Upton, NY (USA); Clark Univ., Worcester, MA (USA); Iowa State Univ. of Science and Technology, Ames (USA); Maryland Univ., College Park (USA)). 1981. Contract AC02-76CH00016. 7p. (CONF-810649—8). NTIS, PC A02/MF A01. Order Number DE81028726.

From 4. international conference on nuclei far from stability; Helsignor, Denmark (7 Jun 1981).

The β decay of ^{148}La to levels in ^{148}Ce has been studied at the TRISTAN ISOL facility at Brookhaven National Laboratory's High Flux Beam Reactor. A level scheme for ^{148}Ce is presented which identifies a first excited 0^+ state at 770.16 keV. 0^+, 2^+, and 4^+ members of the ground state band, as well as 0^+/sub β/, 2^+/sub β/, 4^+/sub β/, 2^+/sub γ/ and the 1^- and 3^- members of an octupole band are identified. IBA-2 calculations for the N=90 isotones and Z=58 isotopes are presented.

29525 (BNL—51380, pp 239-247) **Mass limits on majorana neutrinos from double beta decay.** Rosen, S.P. (Purdue Univ., West Lafayette, IN). 1981. NTIS, PC A15/MF A01.

From Neutrino oscillation workshop; Upton, NY, USA (30 Jan 1981).

Experimental limits on the lifetime for no-neutrino double beta decay in various nuclei are used to set limits on the masses of Majorana neutrinos. In the low-mass region, the limits consist of upper bounds on the neutrino mass; these bounds are now approaching the values obtained from tritium beta decay. In the high-mass region, the limit is a lower bound on the mass of heavy neutrinos. If isospin $\geq$ 3/2 nucleon resonances are found in nuclei at the 1% level, then these lower bounds could be extremely large ($\sim 10^{5-6}$ GeV). When the Majorana neutrinos are not coupled to the weak current with full strength, the bounds relax in proportion to the coupling.

29526 **(LBL—12853) Study of the beta-decay energies of highly neutron-deficient indium isotopes.** Cerny, J.; Aystoe, J.; Cable, M.D.; Haustein, P.E.; Parry, R.F.; Thierens, H.M.; Wouters, J.M. (Lawrence Berkeley Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 9p. (CONF-810649—7). NTIS, PC A02/MF A01. Order Number DE81025826.

From 4. international conference on nuclei far from stability; Helsignor, Denmark (7 Jun 1981).

Following on-line mass separations, the decay energies of / sup 103 to 105/In were measured by β - γ coincidence spectroscopy. The deduced masses of /sup 103 to 105/In are compared to the predictions of different available mass models. For ^{103}In an interesting deviation of -1 MeV from the trends of many theoretical systematic predictions is observed. A broad survey of the masses of the indium isotopes between the closed N=50 and N=82 shells is presented.

29527 **(UCRL—86265) Continued study of the parameterization of the El gamma-ray strength function.** Gardner, M.A.; Gardner, D.G. (Lawrence Livermore National Lab., CA (USA)). 19 Jun 1981. Contract W-7405-ENG-48. 5p. (CONF-810920—2). NTIS, PC A02/MF A01. Order Number DE81023953.

From 4. international symposium on neutron-capture gamma-ray spectroscopy and related topics; Grenoble, France (7 Sep 1981).

The parameterization of the magnitude and the energy dependence of the E1 gamma-ray strength function for the calculation of neutron- and proton-induced capture cross sections and capture gamma-ray spectra is investigated. The energy-dependent Breit-Wigner (EDBW) is reparameterized incorporating a more general expression for the Breit-Wigner line shape. Evaluation of the reparameterized E1 gamma-ray strength function is discussed. (WHK)

29528 **(UCRL—86267) Statistical vs valence neutron neutron capture in ^{98}Mo.** Gardner, D.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Jun 1981. Contract W-7405-ENG-48. 5p. (CONF-810920—1). NTIS, PC A02/MF A01. Order Number DE81023943.

From 4. international symposium on neutron-capture gamma-ray spectroscopy and related topics; Grenoble, France (7 Sep 1981).

It has often been reported that, in mass regions corresponding to peaks in the neutron strength function, nonstatistical mechanisms contribute a significant or even major portion of the average radiation width in the beginning of the resonance region. This could severely limit the possibility of calculating caputure cross sections for targets where experimental data are lacking, because such direct effects are sensitive to the detailed nuclear level structure in the daughter nucleus. The reaction ^{98}Mo+n was examined for neutrons in the 1 keV to 3 MeV energy range, because this case is often cited as one of the clearest examples of valence neutron capture effects. Preliminary calculations are presented which suggest that these nonstatistical effects rapidly disappear when measurements from even a small number of resonances are averaged.

29529 **Nuclear data sheets for A = 139.** Peker, L.K. (National Nuclear Data Center, Brookhaven National Laboratory, Upton, New York, 11973, USA). EY-76-C-02-0016. *Nuclear Data Sheets ;* **32**: No. 1, 1-86(Jan 1981).

The experimental nuclear structure data available through May 1980 have been reviewed. A summary of information obtained in various reaction and decay experiments is presented, together with adopted level schemes.

29530 **Absolute yield of 140.5 keV gamma ray following decay of ^{99}Mo.** Dickens, J.K.; Love, T.A. (Oak Ridge National Lab., TN (USA)). *Nuclear Instruments and Methods ;* **175**: No. 2/3, 535-541(15 Sep 1980).

The absolute intensity for the dominant 140.5 keV gamma ray in ^{99}Tc was determined to be 90.7 +- 0.6 per 100 ^{99}Mo disintegrations for ^{99}Mo decay in equilibrium with decay of the ^{99}Tcsup(*) daughter. Relative intensities for K X-ray and gamma rays emanating from ^{99}Mo in equilibrium with its ^{99}Tcsup(*) daughter were measured using several Ge photon detectors. These include a direct measurement of the very weak 142.6 keV gamma ray. Combining these intensities with an evaluated set of electron-conversion coefficients provided a set of absolute intensities and uncertainties for the observed gamma rays. A complete discussion of the method of analysis, showing relationships among uncertainties of measured and evaluated data, is given.

6518 Nuclear Properties And Reactions, A=150-189

29531 **(BNL—29810) Strengths of E0 transitions in ^{188}Os and ^{196}Pt and the structure of IBA wave functions in the Os-Pt transition region.** Kane, W.R.; Casten, R.F.; Warner, D.D.; Schreckenbach, K.; Faust, H.; Blakeway, S. (Brookhaven National Lab., Upton, NY (USA); Institut Max von Laue - Paul Langevin, 38 - Grenoble (France)). 1981. Contract AC02-76CH00016. 3p. (CONF-810920—6). NTIS, PC A02/MF A01. Order Number DE81027666.

From 4. international symposium on neutron-capture gamma-ray spectroscopy and related topics; Grenoble, France (7 Sep 1981).

As a test of the predictions of the IBA model the strengths of E0 transitions in ^{188}Os and ^{196}Pt were measured. The structure of ^{196}Pt has previously been shown to correspond closely to the predictions of the IBA model in the 0(6) limit and that of ^{188}Os has been interpreted, within the IBA model, in terms of the transition from the 0(6) limit to the well-deformed rotor, or SU(3) limit. In each of these nuclei five excited 0^+ levels have previously been identified, affording the opportunity for a definitive test of the model. Results are presented and discussed. (WHK)

29532 **Nuclear orientation study of ^{166}Ho/sup m/.** Krane, K.S.; Moses, J.D. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] C: Nuclear Physics ;* **24**: No. 2, 654-664(Aug 1981).

Angular distributions have been measured for 25 gamma rays emitted in the decay of ^{166}Ho/sup m/ oriented at low temperatures in paramagnetic neodymium ethyl sulfate and in ferromagnetic Ho metal. The hyperfine Hamiltonians are discussed and parameters describing the strength of the hyperfine interactions are deduced. The reduction of anisotropy in polycrystalline Ho metal is analyzed in detail, with reference to application to nuclear reaction studies using polarized nuclear targets. Spin assignments and multipole mixing ratios are deduced for the levels and transitions in ^{166}Er.

29533 **Selective population of high-j orbitals in Er nuclei by heavy-ion—induced transfer.** Bond, P.D.; Barrette, J.; Baktash, C.; Thorn, C.E.; Kreiner, A.J. (Brookhaven National Laboratory, Upton, New York 11973). DE-AC02-76CH00016. *Physical Review Letters ;* **46**: No. 24, 1565-1568(15 Jun 1981).

Selective population of high-j and high-K states in /sup 167,169,171/Er nuclei has been observed in heavy-ion—induced single-neutron-transfer reactions. Gamma rays in coincidence with outgoing particles have been used to aid in level assignments and several previously unobserved high-j states have been identified.

6519 Nuclear Properties And Reactions, A=190-219

REFER ALSO TO CITATION(S) 29531

29534 **Excitation function for the ^{209}Bi(^{7}Li,5n)^{211}Rn nuclear reaction as a route to the ^{211}Rn-^{211}At generator.** Meyer, G.-J.; Lambrecht, R.M. (Brookhaven National Lab., Upton, NY (USA)). *Journal of Labelled Compounds and Radiopharmaceuticals ;* **18**: No. 1-2, 233(Jan-Feb 1981).

From 3. international symposium on radiopharmaceutical chemistry; St. Louis, MO, USA (16 - 20 Jun 1980).

29535 **Alpha decay and alpha transfer reactions.** De Vries, R.M. (Los Alamos Scientific Lab., NM (USA)). *Nukleonika ;* **24**: No. 1-2, 67-74(1979).

From 9. Summer school of nuclear physics; Mikolajki, Poland (20 Aug - 10 Sep 1978).

Data have been taken for five transitions in the lead region, allowing a quantitative comparison with corresponding alpha-decay data via R-matrix theory using the same target + alpha nuclear potential. Good agreement between the absolute reduced widths determined from the two sets of data suggests that in transfer reactions, as in alpha decay, an alpha particle in its ground state is transferred in a one-step process. In a separate analysis, elastic and total reaction cross sections for the systems α+ ^{206}Pb, ^{209}Bi were analyzed to obtain a limited set of potentials which, in turn, were used to calculate absolute alpha widths. Existing shell model calculations give γ^2sub(α) values three orders of magnitude smaller.

6520 Nuclear Properties And Reactions, A=220 And Above

REFER ALSO TO CITATION(S) 28693, 29172

29536 **(LA—8671) K-components for the ~ 1.4-, ~ 1.6-, and ~ 1.7-MeV structures in the fission of ^{232}Th + n.** Auchampaugh, G.F.; Plattard, S.; Hill, N.W.; de Saussure, G.; Perez, R.B.; Harvey, J.A. (Los Alamos Scientific Lab., NM (USA)). Jul 1981. Contract W-7405-ENG-36. 33p. NTIS, PC A03/MF A01. Order Number DE81028584.

Neutron-induced angle-integrated fission cross sections of ^{232}Th were measured from 0.7 to 9 MeV with a nominal neutron energy resolution of 0.15 ns/m. Data were taken for the angular intervals 0 to 23.4°, 0 to 33.7°, 0 to 51.7°, and 0 to 90°. The structures at ~ 1.4, ~ 1.6, and ~ 1.7 MeV were interpreted in terms of rotational bands with K = 1/2, 3/2, and ≧ 5/2. The approximate relative fission strengths for the K-bonds are in the proportion 1.7:2.4:1.0, 0.0:2.6:1.0, and 1.0:2.8:0.0 for the three structures, respectively.

29537 **Measurement of the fission decay of the giant quadrupole resonance in ^{238}U.** Bertrand, F.E.; Beene, J.R.; Bemis, C.E. Jr.; Gross, E.E. (Oak Ridge National Lab., TN (USA)); Jones, W.P. (Indiana Univ., Bloomington (USA)). *Physics Letters, [Section] B ;* **99**: No. 3, 213-217(19 Feb 1981).

Fission decay of the giant quadrupole resonance has been measured for the ^{238}U(α,α'f) reaction. The fission probability of the resonance is deduced to be 0.25 +- 0.10, while that for the underlying nuclear continuum is 0.21 +- 0.08.

29538 **Target fragment energies and momenta in the reaction of 4.8 GeV ^{12}C and 5.0 GeV ^{20}Ne with ^{238}U.** Loveland, W.; Luo, C.; McGaughey, P.L.; Morrissey, D.J.; Seaborg, G.T. (Department of Chemistry, Oregon State University, Corvallis, Oregon 97551). *Physical Review [Section] C: Nuclear Physics ;* **24**: No. 2, 464-475(Aug 1981).

Target fragment recoil properties were measured using the thick-target—thick-catcher technique for the interaction of 4.8 GeV ^{12}C and 5.0 GeV ^{20}Ne with ^{238}U. The target fragment energies and momenta are very similar for the reaction of 4.8 GeV (400 MeV/nucleon) ^{12}C and 5.0 GeV (250 MeV/nucleon) ^{20}Ne with ^{238}U. In the complex variation of fragment momenta with their N/Z ratio, one finds evidence suggesting the existence of several mechanisms leading to the formation of the target fragments. Comparison of these results with the predictions of the intranuclear cascade model of Yariv and Fraenkel and the firestreak model shows that both model predictions grossly overestimate the target fragment momenta.

29539 **Fission properties of the 1.5-s spontaneous fission activity produced in bombardmentof ^{248}Cm with ^{18}O.** Hoffman, D.C.; Lee, D.; Ghiorso, A.; Nurmia, M.J.; Aleklett, K.; Leino, M. (Chemistry-Nuclear Chemistry Division, MS-760, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] C: Nuclear Physics ;* **24**: No. 2, 495-499(Aug 1981).

We have measured the mass and kinetic-energy distributions of fragments from the spontaneous fission of a 1.5-s activity produced in bombardments of ^{248}Cm with 95-MeV ^{18}O ions. Its spontaneous fission decay exhibits a very symmetric, narrow (full width at half maximum = 12 mass units) mass distribution, a very high total kinetic energy of 234 +- 2 MeV, and increasing total kinetic energy with increasingly symmetric mass division. Based on its half-life and the similarity of its fission properties to the unique fission properties so far only observed for ^{258}Fm and ^{259}Fm, the most likely assignment of this activity is to the known ^{259}Fm. However, assignment to some as yet undiscovered neutron-rich heavy element isotope such as ^{260}Md cannot be unequivocally excluded.

29540 **Fission probability of ^{239}U at high excitation measured with the ^{238}U(α,^{3}He f) reaction.** Wu, J.R.; Beene, J.R.; Bemis, C.E. Jr.; Bertrand, F.E.; Gross, E.E.; Horen, D.J.; Jones, W.P. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Physical Review [Section] C: Nuclear Physics ;* **24**: No. 2, 500-502(Aug 1981).

The fission probability of ^{239}U has been measured as a function of excitation energy using the ^{238}U(α,^{3}He f) reaction with E/sub α/ = 152 MeV. The ^{3}He spectrum in coincidence with fission exhibits a broad peak near the incident beam velocity. The deduced fission probability is the same as that obtained from the ^{238}U(n,f) reaction. This suggests that the neutron transfers to the target forming a compound nucleus ^{239}U, while the ^{3}He, acting as a spectator, escapes with the incoming beam velocity.

29541 **K components for the ~1.4-, ~1.6-, and ~1.7-MeV structures in the fission of ^{232}Th+n.** Auchampaugh, G.F.; Plattard, S.; Hill, N.W.; de Saussure, G.; Perez, R.B.; Harvey, J.A. (University of California, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] C: Nuclear Physics ;* **24**: No. 2, 503-518(Aug 1981).

Neutron-induced angle-integrated fission cross sections of ^{232}Th were measured from 1.3 to 1.8 MeV with a nominal neutron energy resolution of 0.15 ns/m. Data were taken for the angular intervals 0° to 23.4°, 0° to 33.7°, 0° to 51.7°, and 0° to 90°. The structure at ~1.4, ~1.6, and ~1.7 MeV were interpreted in terms of

rotational bands with K = 1/2, 3/2, and > or =5/2. The approximate relative fission strengths for the K bands are in the proportion 1.7:2.4:1.0, 0.0:2.6:1.0, and 1.0:2.8:0.0 for the three structures, respectively.

29542 Fission probabilities for actinide nuclei excited by the (^{12}C, ^{8}Be/sub g.s./) reaction. Cheifetz, E.; Britt, H.C.; Wilhelmy, J.B. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics ;* **24**: No. 2, 519-522(Aug 1981).

Fission probability distributions of ^{236}U and ^{240}Pu compound systems have been measured with the (^{12}C, ^{8}Be/sub g.s./) reaction in the excitation energy range of 7—16 MeV using 65 MeV projectiles. Identification of ^{8}Be/sub g.s./ as two highly correlated alpha particles showed that under the conditions of this experiment ^{8}Be/sub g.s./ can be separated from ^{7}Li in a simple ΔE-E system. The results are in good agreement with fission probabilities derived from neutron induced fission of ^{235}U and ^{239}Pu.

29543 Nuclear data sheets for (even-A) A = 246 through A = 262. Schmorak, M.R. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830, USA). W-7405-ENG-26. *Nuclear Data Sheets ;* **32**: No. 1, 87-209(Jan 1981).

Experimental data pertaining to the nuclear structure of nuclei with even mass numbers A = 246 through A = 262 have been compiled and evaluated (the odd-A mass chains, A = 245 through A = 263, are currently being revised for publication). In many cases where data are lacking, systematics developed by 72ElSc were used to obtain the needed values.

29544 Incipient octupole deformation and parity doublets in the odd mass light actinides. Chasman, R.R. (Argonne National Lab., IL (USA). Chemistry Div.). *Physics Letters,* [*Section*] *B ;* **96**: No. 1/2, 7-10(20 Oct 1980).

A non perturbative method is used to investigate the existence of octupole deformations in the light, odd mass actinides. Calculated level schemes and B(E3) values are presented for several nuclides. Several, almost degenerate, parity doublets are found in the calculations.

6530 Nuclear Theory

29545 (UCRL—53134) Nuclear transmission coefficients for calculation of the absorption cross section in the adiabatic coupled-channel approximation method. Madsen, V.A. (Lawrence Livermore National Lab., CA (USA)). Mar 1981. Contract W-7405-ENG-48. 18p. NTIS, PC A02/MF A01. Order Number DE81028903.

Formulas which are needed to calculate transmission coefficients for the adiabatic coupled-channel approximation method are described. In terms of these coefficients, nuclear absorption cross sections may be obtained. First, derivations are given of various cross sections for a system of coupled inelastic channels in terms of the S matrix. The adiabatic approximation method is discussed for a rotational band, and the dynamical nuclear S matrix is obtained from the S matrix for scattering from a static rotor. The formulas are valid for a spheroidal rotor, with or without an extra-core particle, which does not interact with the projectile but does provide angular momentum to the target.

29546 Cluster emission amplification from nuclei at high angular momenta. Blann, M.; Komoto, T.T. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review* [*Section*] *C: Nuclear Physics ;* **24**: No. 2, 426-439(Aug 1981).

Predictions for statistical decay of highly deformed nuclei using the Hauser-Feshbach formulation are presented including emission of clusters up to ^{12}C. These calculations use the rotating liquid drop model to estimate deformation versus angular momentum. The algorithms used to compute transmission coefficients for spherical and for deformed nuclei are presented, as well as results for several sets of calculations for A = 56 and 148 compound nuclei. Several different formulations are explored for computing decay rates of deformed nuclei. Large cluster emission amplification is predicted when deformation is considered, with consequent decrease in first chance fission. Qualitative comparisons are made with some heavy ion experiments which are consistent with these predictions, and types of experiments to verify the new cluster decay amplification mechanism are suggested. It is pointed out that the phase space dependence on deformation may prove valuable in interpreting some nonequilibrium heavy ion reaction results.

29547 Faddeev wave function decomposition using bipolar harmonics. Friar, J.L.; Tomusiak, E.L.; Gibson, B.F.; Payne, G.L. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics ;* **24**: No. 2, 677-683(Aug 1981).

The standard partial wave (channel) representation for the Faddeev solution to the Schroedinger equation for the ground state of 3 nucleons is written in terms of functions which couple the interacting pair and spectator angular momenta to give S, P, and D waves. For each such coupling there are three terms, one for each of the three cyclic permutations of the nucleon coordinates. A series of spherical harmonic identities is developed which allows writing the Faddeev solution in terms of a basis set of 5 bipolar harmonics: 1 for S waves; 1 for P waves; and 3 for D waves. The choice of a D-wave basis is largely arbitrary, and specific choices correspond to the decomposition schemes of Derrick and Blatt, Sachs, Gibson and Schiff, and Bolsterli and Jezak. The bipolar harmonic form greatly simplifies applications which utilize the wave function, and we specifically discuss the isoscalar charge (or mass) density and the ^{3}He Coulomb energy.

29548 Method for treating the spurious center of mass problem in a dynamically determined basis. Miller, H.G.; Vary, J.P. (Institut fuer Theoreische Physik der Universitaet Frankfurt, 6000 Frankfurt am Main, Federal Republic of Germany). W-7405ENG82. *Physical Review* [*Section*] *C: Nuclear Physics ;* **24**: No. 2, 777-778(Aug 1981).

When a basis space for diagonalizing a multiparticle Hamiltonian is dynamically determined from a set of variational calculations, it is then possible to treat the spurious center of mass motion problem at a level consistent with the treatment of the full solution of the problem. We propose a practical systematic method based on double diagonalization within a variationally determined subspace. The proposed method converges to an exact treatment when the variationally determined subspace spans the full model space.

29549 Pion charge-exchange reaction as a probe of isovector monopole resonances. Bowman, J.D.; Johnson, M.B.; Negele, J.W. (Los Alamos National Laboratory, Los Alamos, New Mexico 87544). *Physical Review Letters ;* **46**: No. 25, 1614-1618(22 Jun 1981).

We argue that the nuclear giant isovector monopole resonance should be observable with pion charge-exchange reactions (π^-,π^0) in the energy region close to the (3,3) resonance.

29550 Energy-indendent nuclear optical potentials. Londergan, J.T.; Miller, G.A. (Department of Physics, Indiana University, Bloomington, Indiana 47405). *Physical Review Letters ;* **46**: No. 23, 1545(8 Jun 1981).

Phase parameters are calculated for nuclear elastic scattering.

29551 Simple method for evaluating Goldstone diagrams in an angular momentum coupled representation. Kuo, T.T.S.; Shurpin, J.; Tam, K.C.; Osnes, E.; Ellis, P.J. (Department of Physics, State University of New York at Stony Brook, Stony Brook, New York 11794). EY-76-5-02-3001;AT(11-1)-1764. *Annals of Physics (New York) ;* **132**: No. 2, 237-276(1 Apr 1981).

A simple and convenient method is derived for evaluating linked Goldstone diagrams in an angular momentum coupled representation. Our method is general, and can be used to evaluate any effective interaction and/or effective operator diagrams for both closed-shell nuclei (vacuum to vacuum linked diagrams) and open-shell nuclei (valence linked diagrams). The techniques of decomposing diagrams into ladder diagrams, cutting open internal lines and cutting off one-body insertions are introduced. These enable us to determine angular momentum factors associated with diagrams in the coupled representation directly, without the need for carrying

out complicated angular momentum algebra. A summary of diagram rules is given.

29552 **Present status of the VMI and related models.** Scharff-Goldhaber, G. (Brookhaven National Lab., Upton, NY (USA)). *Nuclear Physics [Section] A ;* **347**: No. 1/2, 31-50(Sep 1980).

This article traces the evolution of the Variable Moment of Inertia model in its relation to the shell model, the Bohr-Mottelson model, and the Interacting Boson Model. The discovery of a new type of spectrum, that of 'pseudomagic' nuclei (isobars of doubly magic nuclei) is reported, and an explanation for their dynamics is suggested. The type of rotational motion underlying the ground state band of an e-e nucleus is shown to depend on whether the minimum number of valence nucleon pairs of one kind (neutrons or protons) is < 2 or > 2. In the former case the 'alpha-dumbbell model' holds; in the latter, the 'two-fluid model.'.

29553 **Some questions on the Coriolis force, the structure of rotational states, and the IBM.** Khoo, T.L. (Argonne National Lab., IL (USA)). *Nuclear Physics [Section] A ;* **347**: No. 1/2, 407-408(Sep 1980).

Among these questions are: what is the relationship between the nucleon-nucleon interaction and the Coriolis force, and what is the microscopic origin of rotational and vibrational states. In addition, I shall make a few remarks concerning the interacting boson model.

29554 **Survey of research in neutron resonance reactions.** Chrien, R. (Brookhaven National Lab., Upton, NY (USA)). *Physics Reports: A Review Section of Physics Letters (Section C) ;* **64**: No. 5, 337-389(Sep 1980).

It has been pointed out previously that neutron production with synchrotron radiation is feasible. A survey of the field of neutron-induced reactions is presented to describe some of the current topics of interest in the neutron-nuclear physics field. The special properties of neutron production by synchrotron radiation from LEP, especially with respect to to polarization and time structure, make this source attractive to consider in the pursuit of nuclear structure studies with neutrons.

29555 **(π,d) pick-up reaction.** Betz, M. (Argonne National Lab., IL (USA). Physics Div.); Kerman, A.K. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Nuclear Science). *Nuclear Physics [Section] A ;* **345**: No. 2, 493-515(Aug 1980).

The reaction $\pi + A \rightarrow d + B$ at low energy is studied in a one-step DWBA framework. The nuclear structure aspects of the reaction are investigated. The reaction involves mostly neutron or proton pairs of the target nucleus with large total momentum and with total spin equal to zero. In the case of even-even nuclei with a partially filled shell, the coherence of the contributions from different orbitals produces an enhancement of the ground state to ground state transitions. Distortion effects are found to be very large. The final-state interaction is crucial in bringing the magnitude of the differential cross section into satisfactory agreement with the experimental value.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 29017, 29172

29556 (BNL—28832, pp 157-158) **Use of synchrotron radiation for development of uv and x-ray detectors for particle and nuclear physics.** Lu, D.C.; Hughes, V.W. (Yale Univ., New Haven, CT). Jan 1981. NTIS, PC A10/MF A01.

From Workshop on atomic physics at the national synchrotron light source; Upton, NY, USA (15 Sep 1980).

A synchrotron radiation light source can provide a very valuable facility for research in the development of new instrumentation in nuclear and particle physics. The availability of an intense, well-defined beam of uv and x-ray photons of variable frequency will greatly improve the versatility and sophistication of tests in the use of photons in such instrumentation.

29557 **(CONF-810606—78) Bounded limit for the Monte Carlo point-flux-estimator.** Grimesey, R.A. (EG and G Idaho, Inc., Idaho Falls (USA)). 1981. Contract AC07-76ID01570. 6p. NTIS, PC A02/MF A01. Order Number DE81026526.

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

In a Monte Carlo random walk the kernel K(R,E) is used as an expected value estimator at every collision for the collided flux phi/sub c/ r vector,E) at the detector point. A limiting value for the kernel is derived from a diffusion approximation for the probability current at a radius R_1 from the detector point. The variance of the collided flux at the detector point is thus bounded using this asymptotic form for K(R,E). The bounded point flux estimator is derived. (WHK)

29558 **(WAPD-TM—1453) Analytic flux formulas and tables of shielding functions.** Wallace, O.J. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Jun 1981. Contract AC11-76PN00014. 180p. NTIS, PC A09/MF A01. Order Number DE81026559.

Hand calculations of radiation flux and dose rates are often useful in evaluating radiation shielding and in determining the scope of a problem. The flux formulas appropriate to such calculations are almost always based on the point kernel and allow for at most the consideration of laminar slab shields. These formulas often require access to tables of values of integral functions for effective use. Flux formulas and function tables appropriate to calculations involving homogeneous source regions with the shapes of lines, disks, slabs, truncated cones, cylinders, and spheres are presented. Slab shields may be included in most of these calculations, and the effect of a cylindrical shield surrounding a cylindrical source may be estimated. Detector points may be located axially, laterally, or interior to a cylindrical source. Line sources may be tilted with respect to a slab shield. All function tables are given for a wide range of arguments.

29559 **Theory of laser-induced electron transport through molecular gases.** Ritchie, B. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Physical Review [Section] A: General Physics ;* **24**: No. 2, 950-954(Aug 1981).

Conditions are found for the growth of a current in an electron swarm in gaseous media in the presence of intense, monochromatic radiation. For transport to occur by free-free absorption, it is necessary for the medium to have left- or right-handed chirality (as in a sample of chiral molecules), such that the radiative-dipole rate of absorption by the swarm is unequal for electron velocities upsilon-arrow-right and -upsilon-arrow-right relative to the photon direction.

6550 Medical Physics

REFER ALSO TO CITATION(S) 29300

29560 **(LA—8848-MS) Los Alamos personnel and area criticality dosimeter systems.** Vasilik, D.G.; Martin, R.W. (Los Alamos National Lab., NM (USA)). Jun 1981. Contract W-7405-ENG-36. 39p. NTIS, PC A03/MF A01. Order Number DE81026808.

Fissionable materials are handled and processed at the Los Alamos National Laboratory. Although the probability of a nuclear criticality accident is very remote, it must be considered. Los Alamos maintains a broad spectrum of dose assessment capabilities. This report describes the methods employed for personnel neutron, area neutron, and photon dose evaluations with passive dosimetry systems.

29561 **(LA—8911-MS) Nuclear-accident dosimetry: measurements at the Los Alamos SHEBA critical assembly.** Vasilik, D.G.; Martin, R.W.; Fuller, D. (Los Alamos National Lab., NM (USA)). Jul 1981. Contract W-7405-ENG-36. 31p. NTIS, PC A03/MF A01. Order Number DE81026673.

Criticality dosimeters were exposed to different degraded neutron and gamma-ray energy spectra from the Los Alamos Solu-

tion High Energy Burst Assembly (SHEBA). The liquid critical test assembly was operated in the continuous mode to provide a mixed source of neutron and gamma-ray radiation for the evaluation of Los Alamos criticality detector systems. Different neutron and gamma-ray spectra were generated by operating the reactor (a) shielded by 12 cm of Lucite, (b) unshielded, (c) shielded by 20 cm of concrete, and (d) shielded by 15 cm of steel. This report summarizes the dosimetry measurements conducted for these different configurations. In-air measurements were conducted with shielded and unshielded area and personnel dosimeters. Phantom measurements were made using personnel dosimeters. Combined blood-sodium and hair sulfur activation measurements of absorbed dose were also made. In addition, indium foils placed on phantoms were evaluated for the purpose of screening personnel for radiation exposure.

29562 **(LA-UR—81-1694) Improved calculations of energy deposition from fast neutrons.** Brenner, D.J.; Prael, R.E.; Dicello, J.F.; Zaider, M. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 11p. (CONF-810673—2). NTIS, PC A02/MF A01. Order Number DE81025385.

From 4. symposium on neutron dosimetry; Munich-Neuherberg, F.R. Germany (1 Jun 1981).

Increased interest in fast neutrons for radiotherapy has led to a need for accurate measurements and calculations in the energy region up to 100 MeV. Experimental neutron cross sections on elements of biological interest in the region above 15 MeV are sparse. Moreover, until recently, no secondary particle production spectra had been measured in this energy range. New data from the University of California at Davis has allowed cross-sectional calculations to be more firmly based. This in turn results in improved calculations of dose and energy deposition in small sites from high-energy neutrons. Secondary particle production spectra due to neutrons incident on carbon and oxygen are calculated using an intranuclear cascade code which takes into account specific nuclear properties of carbon and oxygen (in particular, alpha-particle clustering). It also allows excited nuclei to deexcite by Fermi breakup rather than the more frequently used statistical evaporation mechanism, which is not applicable to low-mass nuclei. The code yields double-differential secondary particle spectra in energy and angle which show good agreement with the experimental data from the University of California at Davis at 27, 40, and 61 MeV.

29563 **(ORAU—180) Radiation protection enrollments and degrees, 1979 and 1980.** Gove, R.M.; Little, J.R.; Shirley, D.L. (Oak Ridge Associated Universities, Inc., TN (USA)). Jul 1981. Contract AC05-76OR00033. 57p. NTIS, PC A04/MF A01. Order Number DE81027276.

Public concern over the effects of low-level radiation and other aspects of the use of nuclear energy has grown in recent years, and the demand for radiation protection has continued to increase. Radiation Protection Enrollments and Degrees presents the results of the latest survey of institutions offering degree programs in this field. Students obtaining such degrees are vital to the development of industry, medicine, research, power production, construction, and agriculture. These surveys assist state and federal governments in their search for such personnel.

6560 Solid State Physics

REFER ALSO TO CITATION(S) 29006, 29018

29564 (BNL—28832, pp 153-155) **Applications of atomic and molecular synchrotron experiments to condensed matter physics.** Davenport, J.W. Jan 1981. NTIS, PC A10/MF A01.

From Workshop on atomic physics at the national synchrotron light source; Upton, NY, USA (15 Sep 1980).

Synchrotron radiation is expected to be a valuable probe of the geometrical and electronic structure of condensed matter. It appears that the most common experiments will be diffraction and scattering of x-rays and uv photoelectron spectroscopy. To interpret these experiments it is often useful to separate strictly atomic from solid state effects. Hence atomic and molecular experiments serve to map out the range of phenomena to be expected in the absence of bonding. In addition, an atomic effect such as a resonance which is well understood can be used as a diagnostic tool in studies of the condensed state. Several examples of topics of recent interest are given.

29565 **(DOE/ER/03533—189) Algebraic formulation of duality.** Rajeev, S.G. (Syracuse Univ., NY (USA). Dept. of Physics). Mar 1981. Contract AS02-76ER03533. 9p. (COO—3533-189; SU—4217-189). NTIS, PC A02/MF A01. Order Number DE81025968.

Two dimensional lattice spin (chiral) models over (possibly non-abelian) compact groups are formulated in terms of a generalized Pauli algebra. Such models over cyclic groups are written in terms of the generalized Clifford algebra. An automorphism of this algebra is shown to exist and to lead to the duality transformation.

29566 **(DOE/ER/10443—2) High-pressure studies to determine the effects of volume and temperature on the lattice dynamics of molecular solids: N_2, CO_2, CH_4. Progress report, July 1, 1980-June 30, 1981.** Medina, F.D. (Northeastern Univ., Boston, MA (USA)). May 1981. Contract AS02-79ER10443. 8p. NTIS, PC A02/MF A01. Order Number DE81025963.

Studies summarized in this report on research programs at Northeastern University include: far infrared absorption spectroscopy of solid nitrogen; a study of volume and temperature dependence of the Raman soectrum in phase II of solid methane; the collision-induced light scattering spectrum of fluid methane; the light scattering spectrum of fluid nitrogen at 157°K and densities between 128 and 462 amagat; growth of β-N_2 at pressures of 2.7 and 4.6 Kbar on the melting line and cooling to the alpha phase; measurement of the breathing mode frequency of the methane molecule at 240°K up to density of 800 amagat; and growth of samples of solid methane. (GHT)

29567 **(LA-UR—81-1782) Effect of shock waves on the absorption spectrum of ruby.** Hixson, R.S.; Bellamy, P.M.; Duvall, G.E.; Wilson, C.R. (Los Alamos National Lab., NM (USA); Washington State Univ., Pullman (USA)). 1981. Contract W-7405-ENG-36. 6p. (CONF-810684—37). NTIS, PC A02/MF A01. Order Number DE81025297.

From APS conference on shock waves in condensed matter; Menlo Park, CA, USA (23 Jun 1981).

The effect of shock loading upon the unpolarized absorption spectrum of ruby has been measured. Experiments were performed both above and below the Hugoniot elastic limit (HEL), with the experiment above the elastic limit failing due to extinction of the light upon impact. The experiments below the elastic limit were both done at about the same pressure ($\sim$ 100 kbar), and show a shift of both absorption bands in the visible region toward shorter wavelength, the shifts agreeing well with those measured at a comparable hydrostatic pressure.

29568 **(LBL—12930) Surface-enhanced nonlinear optical effects and detection of adsorbed molecular monolayers.** Shen, Y.R.; Chen, C.K.; Heinz, T.F.; Ricard, D. (California Univ., Berkeley (USA). Dept. of Physics; Lawrence Berkeley Lab., CA (USA)). 1981. Contract W-7405-ENG-48. 9p. (CONF-8106100—3). NTIS, PC A02/MF A01. Order Number DE81027097.

From International conference on laser spectroscopy; Alberta, Canada (29 Jun 1981).

The observation of a number of surface-enhanced nonlinear optical effects is discussed. The feasibility of using second-harmonic generation to detect the adsorption of molecular monolayers on a metal surface in an electrolytic solution is shown.

29569 **(SAND—81-1194C) Constitutive modelling for the shock physicist.** Herrmann, W. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 14p. (CONF-810684—36). NTIS, PC A02/MF A01. Order Number DE81024063.

From APS conference on shock waves in condensed matter; Menlo Park, CA, USA (23 Jun 1981).

Despite the fact that the theory of constitutive equations has been well developed in continuum mechanics, the literature contin-

ues to blossom with constitutive equations fabricated from many ad-hoc assumptions, some of which may be inconsistent or implicit, and are often very restricted in the types of motion to which they are applicable. Many of these constitutive equations in fact are special cases of general constitutive theories which have been studied in detail, and for which many general properties are known. The methodology of continuum constitutive theory will be reviewed, with some examples drawn from viscous, viscoelastic, viscoplastic and mixture theories which have recently been applied to describing certain features of shock wave propagation.

6561 Superconductivity

REFER ALSO TO CITATION(S) 28993, 28995, 28999, 29000

29570 **(IS-M—297) Superconducting proximity effect for in situ and model layered systems.** Finnemore, D.K. (Ames Lab., IA (USA)). 1980. Contract W-7405-ENG-82. 19p. (CONF-800839—2). NTIS, PC A02/MF A01. Order Number DE81025530.

From NATO advanced study institute superconducting materials-science and technology; Lisbon, Portugal (19 Aug 1980).

The primary drawback for in situ composites is that the ac losses are higher than for mechanically produced multifilamentary wire. To develop an understanding of the proximity effect so that analytical expressions will be available for design, a model system is developed based on PbCd. Items discussed include boundary conditions at SN interface, phonon spectral function, supercurrents through normal barriers, flux entry fields, and implications for in situ composites. (GHT)

6570 Theoretical Physics

REFER ALSO TO CITATION(S) 29569

29571 **(DOE/ER/70019—T8) Numerical inversion of the Laplace transform and multidimensional heat equations.** Angel, E. (University of Southern California, Los Angeles (USA). Dept. of Electrical Engineering). Jan 1970. Contract AT03-76ER70019. 11p. NTIS, PC A02/MF A01. Order Number DE81026129.

The technique presented in this paper is based upon the use of the Laplace transform. The Laplace transform of a parabolic equation yields an elliptic equation in all the space variables and the new variables, which we regard as a parameter. For a carefully chosen but small set of values of s we solve the transformed equation numerically. The feasibility of the technique rests on our ability to invert the transform so as to recover the desired function. The work of Bellman, et at, shows that a suitable inversion formula can be easily computed or looked up in tables.

29572 **(LA-UR—81-1928) Energy losses in conductors carrying very high currents.** Singer, S.; Hunter, R.O. (Los Alamos National Lab., NM (USA); Western Research Corp., San Diego, CA (USA)). 1981. Contract W-7405-ENG-36. 8p. (CONF-810659—13). NTIS, PC A02/MF A01. Order Number DE81025367.

From 3. IEEE international pulsed power conference; Albuquerque, NM, USA (1 Jun 1981).

Conductors carrying very high currents show losses of an electromagnetic and a shock compression nature. Electromagnetic losses (joule heating in the skin layer, magnetic flux diffusion) scale as H^3 or $(I/a)^3$, where H is the self magnetic field of the current and I/a is the current divided by conductor - periphery; shock losses scale as H^4 or H^3 [$(I/a)^4$ or $(I/a)^3$] depending on the magnitude of I. In experiments where electrical energy must be converged from a large pulsed power supply to a small load, these losses can account for half the orignal energy and limit the magnitude of the energy per unit volume in the load. These considerations may be important for the study of material properties at high energy density.

29573 **Low density phases of the electron gas.** Ceperley, D.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.); Alder, B.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). *Journal de Physique (Paris), Colloque ;* p. 295-298(1980).

From CNRS international colloquium on spin polarized quantum systems; Aussois, France (21 - 26 Apr 1980).

We have generalized the quantum Monte Carlo method for bosons to exactly simulate the ground state of many-fermion systems. We have carried out such simulations on the one component plasma with up to 250 electrons and determined the equation of state in three phases: the normal (unpolarized) Fermi liquid, the polarized Fermi liquid and the Wigner crystal. Two phase transitions are seen: from the normal liquid to the polarized at rsub(s)=75, and from the polarized liquid to the Wigner crystal at rsub(s)=100 where rsub(s) is the mean interparticle spacing in Bohr radii.

29574 **Diffuse wave fields in solid media.** Egle, D.M. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Journal of the Acoustical Society of America ;* **70**: No. 2, 476-480(Aug 1981).

The diffuse-field concept is applied to develop the power balance equations relating the time-averaged energy densities associated with longitudinal and transverse waves to the diffuse-field mode conversion coefficients and the power generated by sources in the medium. A solution for an impulsive source in a solid with stress-free surfaces shows that, regardless of the initial partition of energy, the transverse-wave energy density quickly increases to become the dominant energy form in the medium.

29575 **Can we make sense out of the measurement process in relativistic quantum mechanics?.** Aharonov, Y.; Albert, D.Z. (Physics Department, Tel Aviv University, Ramat Aviv, Israel). DE-AC02-76ER02232B.000. *Physical Review [Section] D: Particles and Fields ;* **24**: No. 2, 359-370(15 Jul 1981).

We study the instantaneity of the state-reduction process in relativistic quantum mechanics. The conclusion of various authors that this instantaneity will restrict the set of relativistic observables to purely local ones (i.e., that the measurement of any nonlocal property of a system at a well-defined time would give rise to violations of relativistic causality) is found to be erroneous, and experiments (of a kind not encountered before in measurement theory) are described whereby certain nonlocal properties of some simple physical systems can be measured at a well-defined time without violating causality. The attempts of certain authors to reconcile the reduction process with the covariance of the relativistic quantum state are considered and found wanting, and it is argued that the covariance of relativistic quantum theories resides exclusively in the experimental probabilities, and not in the underlying quantum states. The problem of nonlocal measurement is considered in general: distinctions (which are not to be met with in the nonrelativistic case) arise in relativistic quantum mechanics between what can be measured for fermions and what can be measured for bosons, between what can be measured for individual systems and what can be measured for ensembles, and between what kinds of states can be verified by measurement and what kinds of states can be prepared by measurement; and these pose difficult questions about the nature of measurement itself.

29576 **Calculation of the statistical properties of strange attractors.** Jensen, R.V.; Oberman, C.R. (Princeton Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). DE-AC02-76-CH0-3073. *Physical Review Letters ;* **46**: No. 24, 1547-1550(15 Jun 1981).

A path-integral method is developed for the calculation of the statistical properties of a class of dissipative mappings which exhibit strange attractors. Exact analytic results are derived for the low-order statistical moments. These nontrivial results are verified numerically.

29577 **Heat regeneration in Malone-type liquid engines using a parallel-plate thermodynamic pile geometry.** Allen, P.C.; Fisher, G.H.; Knight, W.R.; Paulson, D.N.; Wheatley, J.C. (Department of Physics, University of California, San Diego, La Jolla, California 92093). DE-AS03-76-SF00034. *Journal of Applied Physics ;* **52**: No. 6, 3876-3883(Jun 1981).

Liquids working in heat engines require especially effective thermal regeneration as they flow between the remote and ambient temperature regions of a machine. Using liquid Freon 114 ($C_2Cl_2F_4$) as a test fluid, we have studied this process experimentally in a parallel-plate geometry for the pulsating unidirectional flow of a Malone engine. A theoretical analysis of the thermohydrodynamical process is presented whose results compare favorably with experiment. For a constant average volume rate of flow of liquid, the regenerative loss decreases as the period of the engine decreases.

29578 **Functional integral approach to classical statistical dynamics.** Jensen, R.V. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). DE-AC02-76-CH03073. *Journal of Statistical Physics ;* **25**: No. 2, 183-210(Jun 1981).

The functional integral method for the statistical solution of differential equations is extended to a broad, new class of nonlinear dynamical equations with random coefficients and initial conditions. This work encompasses previous results for classical systems with random forces and initial conditions with arbitrary statistics and provides new results for systems with nonlinear interactions which are nonlocal in time. Closed equations of motion for the correlation and response functions are derived which have applications in the calculation of particle motion in stochastic magnetic fields, in the solution of stochastic wave equations, and in the description of electromagnetic plasma turbulence. As an illustration of the new results for nonlocal interactions, the electromagnetic dispersion tensor is calculated to first order in renormalized theory.

29579 **Statistical approach to quantum mechanics.** Creutz, M.; Freedman, B. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). DE-A02-76CH00016. *Annals of Physics (New York) ;* **132**: No. 2, 427-462(1 Apr 1981).

A Monte Carlo method is used to evaluate the Euclidean version of Feynman's sum over particle histories. Following Feynman's treatment, individual paths are defined on a discrete (imaginary) time lattice with periodic boundary conditions. On each lattice site, a continuous position variable x/sub i/ specifies the spacial location of the particle. Using a modified Metropolis algorithm, the low-lying energy eigenvalues, ' $psi_0(x)'^2$, the propagator, and the effective potential for the anharmonic oscillator are computed, in good agreement with theory. For a deep double-well potential, instantons were found in our computer simulations appearing as mulit-kink configurations on the lattice.

29580 **Generalization of the proximity force theorem.** Blocki, J.; Swiatecki, W.J. (Institute for Nuclear Research, Swierk 05-400, Poland). W-7405-ENG-48. *Annals of Physics (New York) ;* **132**: No. 1, 53-65(Mar 1981).

We generalize the Proximity Force Theorem of J. Blocki et al. (Ann. Phys. (N. Y.) 105 (1977), 427) (valid for gently curved surfaces) to include surfaces that may have large curvatures (but are still characterized by small angles between relevant portions of the interacting surfaces). A general proof is given for the approximate concinuity of the proximity force when a gap configuration goes over into a crevice after contact. Simple and somewhat improved formulae are given for the universal proximity potential functions Phi and Phi-circumflex for gaps and crevices.

6580 Mathematical Physics

REFER ALSO TO CITATION(S) 29565

29581 **(ANL—81-39) Estimation of sparse jacobian matrices and graph coloring problems.** Coleman, T.F.; More, J.J. (Argonne National Lab., IL (USA)). Jun 1981. Contract W-31-109-ENG-38. 43p. NTIS, PC A03/MF A01. Order Number DE81027136.

Given a mapping with a sparse Jacobian matrix, the problem of minimizing the number of function evaluations needed to estimate the Jacobian matrix by differences is investigated. This problem can be attacked as a graph coloring problem and this approach leads to very efficient algorithms. The behavior of these algorithms is studied and, in particular, it is proved that two of the algorithms are optimal for band graphs. Numerical evidence is presented which indicates that these two algorithms are nearly optimal on practical problems.

29582 **(BNL—29719) Physics in few dimensions.** Emery, V.J. (Brookhaven National Lab., Upton, NY (USA)). Mar 1981. Contract AC02-76CH00016. 10p. (CONF-810385—1). NTIS, PC A02/MF A01. Order Number DE81026054.

From Conference on non-linear problems: present and future; Los Alamos, NM, USA (Mar 1981).

This article is a qualitative account of some aspects of physics in few dimensions, and its relationship to nonlinear field theories. After a survey of materials and some of the models that have been used to describe them, the various methods of solution are compared and contrasted. The roles of exact results, operator representations and the renormalization group transformation are described, and a uniform picture of the behavior of low-dimensional systems is presented.

29583 **(DOE/ER/13065—T1) QCD sum-rules for V-A spectral functions.** Chakrabarti, J.; Mathur, V.S. (Rochester Univ., NY (USA). Dept. of Physics and Astronomy). 1980. Contract AC02-76ER13065. 12p. (COO—3065-300; UR—784). NTIS, PC A02/MF A01. Order Number DE81026196.

The Borel transformation technique of Shifman et al is used to obtain QCD sum-rules for V-A spectral functions. In contrast to the situation in the original Weinberg sum-rules and those of Bernard et al, the problem of saturating the sum-rules by low lying resonances is brought under control. Furthermore, the present sum-rules, on saturation, directly determine useful phenomenological parameters.

70 FUSION ENERGY

7001 Plasma Research

29584 **(CONF-810680—1) Physics issues of an EBT reactor.** Uckan, N.A. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 11p. NTIS, PC A02/MF A01. Order Number DE81023219.

From Symposium on physics problems of fusion reactors; Trieste, Italy (2 Jun 1981).

The plasma physics areas that influence the operating characteristics of EBTs are the following: (1) particle orbits, equilibrium, and magnetic; (2) stability boundaries of both core and ring plasmas; (3) transport scaling; (4) heating; and (5) ring-core interaction and power balance. In addition to the conventional mode of EBT operation, innovative ideas that enhance the reactor performance include: (a) the use of supplementary (and/or trim) coils to improve confinement (and/or stability); (b) control of ambipolar potential (and its sign, i.e., positive electric field) to enhance confinement (and to be able to burn alternative fuels, i.e., D-D, etc., in a reasonably sized reactor); and (c) the possibility of fundamental ring mode heating to reduce microwave frequency requirements by a factor of 2. This paper reviews each of these areas briefly and discusses their projections to a reactor.

29585 **(CONF-810906—5) Plasma heating from alpha particle micro-instabilities.** Miley, G.H.; Sutton, W.R.; Choi, C.K. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 1981. Contract AS02-76ET52040. 4p. (COO—2218-217). NTIS, PC A02/MF A01. Order Number DE81025050.

From 10. European conference on controlled fusion and plasma physics; Moscow, USSR (14 Sep 1981).

Potential use of thermonuclear (i.e., fusion product) driven kinetic instabilities to heat the background plasma has long been recognized. Considerable research on velocity space micro-instabilities exists. Most work to date has focused upon the basic physics criteria for and characteristics of particular micro-instabilities. Kinetic instabilities resulting in spatial transport of fusion products have also received some attention, but the effects on reactor concepts and performance remain uncertain. We have developed an engineering model which scopes the effect of a velocity space relaxation of fast alphas on a quasi-linear time scale. This model includes the additional heating to background plasma ions under the assump-

tions of: ion damping of the plasma wave; heating to background plasma results predominantly from fusion products; and periodic hiccups of the instability.

29586 **(DOE/ET/51002—1) Trajectory analysis of the electrons in a magnetron-type gun. Progress report.** Ezzeddine, A.; Smullin, L.D. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Sep 1980. Contract AS02-78ET51002. 26p. NTIS, PC A03/MF A01. Order Number DE81027860.

Modification is introduced in the Herrmannsfeldt electron trajectory code to analyze the trajectories in magnetron injection guns with perveances I/V/sup 3/2/ in the range of 10^{-8} Perv. When tested on a particular magnetron gun, the computed perveance agreed well with experimental data for values V/B/sup 2/ less that or equal to 0.006, the flow was nearly laminar with V/sub perpendicular//V/sub parallel/ values reaching 12%. For larger voltages, both experiment and calculations indicate a turbulent electron flow.

29587 **(DOE/ET/51013—4) Theory of electron cyclotron heating in the Constance II experiment.** Mauel, M.E. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Mar 1981. Contract AC02-78ET51013. 30p. (PFC/RR—81-2R). NTIS, PC A03/MF A01. Order Number DE81028269.

The bounce-averaged quasi-linear equation for a non-relativistic mirror-confined plasma interacting with electromagnetic waves is derived for use in the study of ECRH of the Constance II mirror experiment. The derivations follows the more formal examples given by Berk for electrostatic waves and Bernstein and Baxter for relativistic plasmas. The validity of the theory is discussed by examining individual particle orbits in an EM field. The local dispersion relation is found while deriving a self-consistent WKB theory which can be used to estimate the power transferred from the launching horn to the plasma.

29588 **(GA-A—15931) Parameter for the vertical-position control of dee-shaped plasmas in Doublet III.** Yokomizo, H.; Seki, S.; Shimada, M.; Nagami, M.; Konoshima, S.; Fujisawa, N.; Ohara, Y.; Ioki, K.; Kitsunezaki, A. (General Atomic Co., San Diego, CA (USA); Japan Atomic Energy Research Inst., Tokyo). Jun 1981. Contract AT03-80SF11512. 15p. NTIS, PC A02/MF A01. Order Number DE81028606.

A simple method has been developed using three magnetic probes to detect the vertical position of the center of dee-shaped plasmas located in the upper lobe of Doublet III. This parameter has no dependence on the plasma current and only a small dependence on the horizontal (radial) position of the plasma column. The comparison between the new parameter and the result of MHD calculation shows good correlation with the vertical position of the plasma center. This provides an effective means for improving control of the plasma position and maintaining stable dee plasmas.

29589 **(IAEA-CN—38/N-1) Neutral beam injection experiments in the ISX-B tokamak.** Murakami, M.; Bates, S.C.; Bush, C.E. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 13p. NTIS, PC A02/MF A01. Order Number DE81025621.

Injection of up to 1 MW H^0 beam into D^+ plasmas has produced root-mean-square beta up to 3.3%, volume-averaged beta up to 2.3%, and central beta up to 8% in the ISX-B tokamak. Although theoretical calculations indicate the observed equilibria should be unstable to ballooning instabilities, no catastrophic loss of confinement has been observed, and beta continues to increase with injection power. In these beam-dominated high-β discharges, the electron and ion energy confinement times are still similar to those obtained with ohmic heating. In the beam-dominated discharges the character of the MHD behavior changes, the particle confinement time decreases, and the inward impurity transport appears to be inhibited. These effects, however, may not be linked directly to beta. Understanding tokamak beta limits will require further test with increased injection power, low q operation, elongated plasmas, and more diagnostic capabilities, as planned for ISX-B, as well as more detailed studies of other effects of high power injection.

29590 **(LA—8823-MS) Spatially resolved spectrometer system for the ZT-40 device.** Watt, R.G. (Los Alamos National Lab., NM (USA)). May 1981. Contract W-7405-ENG-36. 7p. NTIS, PC A02/MF A01. Order Number DE81026683.

A spatially resolved emission spectroscopy system designed for use on the ZT-40 device at the Los Alamos National Laboratory is described. The three-chord system consists of independent dispersive elements and detectors for each chord, on a common wavelength drive. The system has been installed and is currently in use on ZT-40. Preliminary results of CV (227.1 nm) line radiation measurements are presented.

29591 **(LA—8896-MS) Plasma-current fluctuations and decay-rate behavior in the ZT-40 device.** Watt, R.G. (Los Alamos Scientific Lab., NM (USA)). Jul 1981. Contract W-7405-ENG-36. 12p. NTIS, PC A02/MF A01. Order Number DE81026426.

A detailed examination of the behavior of the fluctuations of dI/sub plasma//dt in the ZT-40 device over 2500 shots is presented. Historical variations in these fluctuations are discussed along with several possible explanations of these variations. The dependence of these fluctuations on fill pressure, B/sub phi/ at the wall, and the relation of these I/sub phi/ fluctuations to the decay of the plasma current are examined. A physical picture consistent with the observed data is presented to explain the relation between the current decay and fluctuations, and the dependence of the fluctuations on B/sub phi/ wall.

29592 **(LA-UR—81-1697) Maximal entropy in fluid and plasma turbulence: a review.** Montgomery, D. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 21p. (CONF-8106116—1). NTIS, PC A02/MF A01. Order Number DE81025388.

From Workshop on maximum entropy estimation and data analysis; Laramie, WY, USA (8 Jun 1981).

Three recent applications of maximal entropy procedures to models of turbulence in plasmas are described. They are: (1) the calculation of most probable states in guiding-center plasmas and vortex fluids; (2) the calculation of most probable magnetohydrodynamic equilibrium profiles; and (3) the prediction of absolute equilibrium Gibbs ensemble spectra for Navier-Stokes fluids. Further conjectures on the role of entropies in turbulence theories are offered.

29593 **(LA-UR—81-1711) Time-resolved x-ray diagnostics.** Lyons, P.B. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 8p. (CONF-8106108—2). NTIS, PC A02/MF A01. Order Number DE81025387.

From Low energy X-ray conference; Monterey, CA, USA (Jun 1981).

Techniques for time-resolved x-ray diagnostics will be reviewed with emphasis on systems utilizing x-ray diodes or scintillators. System design concerns for high-bandwidth (> 1 GHz) diagnostics will be emphasized. The limitations of a coaxial cable system and a technique for equalizing to improve bandwidth of such a system will be reviewed. Characteristics of new multi-GHz amplifiers will be presented. An example of a complete operational system on the Los Alamos Helios laser will be presented which has a bandwidth near 3 GHz over 38 m of coax. The system includes the cable, an amplifier, an oscilloscope, and a digital camera readout.

29594 **(LA-UR—81-1860) Heating of a dense plasma with an intense relativistic electron beam: initial observations.** Montgomery, M.D.; Parker, J.V.; Riepe, K.B.; Sheffield, R.L. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 9p. (CONF-810620—8). NTIS, PC A02/MF A01. Order Number DE81025348.

From 4. international topical conference on high-power electron and ion-beam research and technology; Palaiseau, France (29 Jun 1981).

A dense ($\sim 10^{17}$ cm^{-3}) plasma has been heated via the relativistic two-stream instability using a 3 MeV, intense (5×10^5 A/cm^2) electron beam. Evidence for heating has been obtained with diamagnetic loops, thin-foil witness plates, and a 2-channel, broad-

band soft x-ray detector. Measurements of energy loss from the beam using calorimetry techniques have been attempted. The measured strong dependence of heating on beam transverse temperature and the very short interaction length (<4 cm) are consistent with beam-plasma coupling due to the relativistic electron-electron two-stream instability. Soft x-ray measurements made >100 ns after the beam pulse are consistent with a plasma temperature <150 eV and line emission near 80 to 90 eV.

29595 **(LBL—12688) Multi-dimensional canonical/symplectic maps for gyro-resonance crossings.** Grebogi, C.; Kaufman, A.N. (Lawrence Berkeley Lab., CA (USA)). Mar 1981. Contract W-7405-ENG-48. 21p. (CONF-810356—2). NTIS, PC A02/MF A01. Order Number DE81025322.

From Workshop on long-time prediction in nonlinear conservative dynamical systems; Austin, TX, USA (16 Mar 1981).

The locally resonant interaction of a magnetically confined charged particle with a high-frequency electromagnetic wave can be modeled by a mapping of the particle's phase space. This mapping represents the jump in the dynamical variables caused by each passage through the resonance zone. Two formalisms are presented for mappings which preserve the phase-space structure: the Poincare transformation, appropriate for canonical variables; and the Lie map, valid for any coordinate system on phase space. In both cases, the generating function for the map is the action integral, across the resonance, of the interaction Lagrangian. In the non-resonant region of phase space, the interaction is transformed to higher order by standard Lie methods. Particle motion in this (adiabatic) region can then be represented also by a mapping. Consequently, the Hamiltonian flow in phase space can be replaced by iterates of a composite map, the product of the resonance and adiabatic maps.

29596 **(LBL—12942) Hamiltonian theory of guiding-center motion.** Littlejohn, R.G. (Lawrence Berkeley Lab., CA (USA)). May 1980. Contract W-7405-ENG-48. 233p. NTIS, PC A11/MF A01. Order Number DE81027401.

Thesis.

A Hamiltonian treatment of the guiding center problem is given which employs noncanonical coordinates in phase space. Separation of the unperturbed system from the perturbation is achieved by using a coordinate transformation suggested by a theorem of Darboux. As a model to illustrate the method, motion in the magnetic field B=B(x,y)z is studied. Lie transforms are used to carry out the perturbation expansion.

29597 **(ORNL/TM—7636) Formulas and subroutines for vector B, vector del vector B, and psi of a current loop with application to magnetic fusion experiments.** Goldfinger, R.C. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 53p. NTIS, PC A04/MF A01. Order Number DE81027631.

The formulas for the magnetic field due to a current loop are well known and are readily expressed ina cylindrical coordinate system using elliptic integrals. However, there are numerical difficulties which are not widely recognized in evaluating the standard expressions near the axis of the current loop (rho = 0). This work presents a set of formulas and FORTRAN subroutines in cylindrical and cartesian coordinates for vector B, vector del vector B, and psi (the magnetic flux), which are accurate everywhere and which can be computed efficiently. The subroutines automatically optimize the calculation to give answers that are accurate to within one or two significant figures of the maximum number available on the user's computer. Application of these results is made to simulate the vacuum magnetic field and plasma density in the Oak Ridge National Laboratory ELMO Bumpy Torus experiment.

29598 **(ORNL/TM—7722) Ion-beam extraction from a plasma with aberration reduction by method of mutual exclusion.** Whealton, J.H.; McGaffey, R.W.; Stirling, W.L. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 27p. NTIS, PC A03/MF A01. Order Number DE81027597.

Using an algorithm for solution of the Poisson-Vlasov equations for ions extracted from a plasma, an electrode shape is considered which has high optimum perveance and low beam divergence.

29599 **(ORNL/TM—7807) Safety factor profile optimization of high-n ballooning-mode stability of tokamaks.** Cooper, W.A. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 19p. NTIS, PC A02/MF A01. Order Number DE81027618.

Conditions of improved stability to high-n ideal MHD modes are obtained with equilibria generated by flattening and raising the safety factor (q) profile. Flat q profiles shorten the connection length for high-n ballooning modes and diminish the destabilizing impact of the geodesic curvature. High values of q stabilize the residual interchange modes.

29600 **(ORNL/TM—7835) Ion-optics-extraction arithmetic.** Whealton, J.H. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 65p. NTIS, PC A04/MF A01. Order Number DE81027445.

Arithmetic algorithms for ion extraction from a plasma are examined, instabilities are delineated, and ancillary results are presented.

29601 **(PPPL—1770) Use of the TFTR prototype charge exchange neutral analyzer for fast He_3ii diagnostics during ICRF heating on PLT.** Medley, S.S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jul 1981. Contract AM02-76CH03073. 21p. NTIS, PC A01/MF A01. Order Number DE81027472.

The Charge Exchange Neutral Analyzer (CENA) for TFTR is designed to measure singly charged ion species of atomic mass A = 1, 2, and 3 simultaneously with up to 75 energy channels per mass and an energy range of 0.5 < AE < 600, where AE is in units of AMU.keV. Plans to test the prototype analyzer on PLT prior to installation on TFTR are discussed. The capability of the analyzer to simultaneously measure singly reionized H, D, and He_3 charge exchange neutrals makes the analyzer of particular interest for recently proposed fast He_3^{++} diagnostics during ICRF heating on PLT.

29602 **(PPPL—1780) Statistical properties of chaotic dynamical systems which exhibit strange attractors.** Jensen, R.V.; Oberman, C.R. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jul 1981. Contract AC02-76CH03073. 42p. NTIS, PC A03/MF A01. Order Number DE81027471.

A path integral method is developed for the calculation of the statistical properties of turbulent dynamical systems. The method is applicable to conservative systems which exhibit a transition to stochasticity as well as dissipative systems which exhibit strange attractors. A specific dissipative mapping is considered in detail which models the dynamics of a Brownian particle in a wave field with a broad frequency spectrum. Results are presented for the low order statistical moments for three turbulent regimes which exhibit strange attractors corresponding to strong, intermediate, and weak collisional damping.

29603 **(PPPL—1799) Electrostatic analysis of the tokamak edge plasma.** Motley, R.W. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jul 1981. Contract AM02-76CH03073. 36p. NTIS, PC A03/MF A01. Order Number DE81027517.

The intrusion of an equipotential poloidal limiter into the edge plasma of a circular tokamak discharge distorts the axisymmetry in two ways: (1) it (partially) shorts out the top-to-bottom Pfirsch-Schlueter driving potentials, and (2) it creates zones of back current flow into the limiter. The resulting boundary mismatch between the outer layers and the inner axisymmetric Pfirsch-Schlueter layer provides free energy to drive the edge plasma unstable. Special limiters are proposed to symmetrize the edge plasma and thereby reduce the electrical and MHD activity in the boundary layer.

29604 **(PPPL—1801) Magneto-optically modulated CH_3OH laser for Faraday rotation measurements in tokamaks.** Mansfield, D.K.; Johnson, L.C. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jul 1981. Contract AM02-76CH03073. 20p. NTIS, PC A02/MF A01. Order Number DE81027298.

Distortion-free intracavity polarization modulation of an optically pumped CH_3OH laser is shown to be viable. The possible

use of this modulation technique to make a multichannel Faraday rotation measurement on a Tokamak device is discussed. In addition, the CdTe Faraday modulator employed in this study is shown to have an anomalously large Verdet constant.

29605 **(PPPL—1808) Currents driven by electron cyclotron waves.** Karney, C.F.F.; Fisch, N.J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jul 1981. Contract AM02-76CH03073. 30p. NTIS, PC A03/MF A01. Order Number DE81027297.

Certain aspects of the generation of steady-state currents by electron cyclotron waves are explored. A numerical solution of the Fokker-Planck equation is used to verify the theory of Fisch and Boozer and to extend their results into the nonlinear regime. Relativistic effects on the current generated are discussed. Applications to steady-state tokamak reactors are considered.

29606 **(PPPL—1812) Ballooning stability in toroidal devices.** Yoshikawa, S. (Princeton Univ., NJ (USA). Plasma Physics Lab.; Texas Univ., Austin (USA). Inst. for Fusion Studies). Jul 1981. Contract AM02-76CH03073. 19p. NTIS, PC A02/MF A01. Order Number DE81027299.

The marginal stability condition of ballooning instabilities for toroidal confinement devices is derived for low critical stability β ($\beta \leqq 10\%$). The stability condition derived here should be applicable to EBT and multipoles as well as tokamaks and stellarators. For EBT and multipoles a more compact expression for the stability condition is possible and is given here in the appendix.

29607 **(PPPL—1816) Electrostatic waves in general magnetic field configurations.** Chen, L.; Tsai, S.T. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jul 1981. Contract AM02-76CH03073. 22p. NTIS, PC A02/MF A01. Order Number DE81027567.

A scheme for investigating linear electrostatic waves in general magnetically confined plasmas is presented. The scheme is a generalization of the low-frequency (less than the cyclotron frequency) gyrokinetic formalism of Rutherford and Frieman as well as Taylor and Hastie to arbitrary frequencies. Governing integral wave equations for slab plasmas with magnetic shear as well as axisymmetric tokamaks are then derived to illustrate the applications.

29608 **(PPPL—1817) Ideal and resistive MHD stability of one-dimensional tokamak equilibria.** Chance, M.S.; Furth, H.P.; Glasser, A.H.; Selberg, H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jul 1981. Contract AC02-76CH03073. 46p. NTIS, PC A03/MF A01. Order Number DE81028540.

The MHD equilibrium and stability of a vertically elongated tokamak configuration are analyzed in the one-dimensional limit corresponding to infinite elongation. Stability against all ideal MHD modes can be obtained for beta-values arbitrarily close to unity. In the finite-resistivity stability analysis, axisymmetric (m = 0) tearing modes, centered on the null trace of the poloidal field, can be stabilized by a loosely fitting conducting shell. The presence of the toroidal field component, however, introduces the possibility of nonsymmetric tearing modes (m not equal to 0), centered away from the null trace. These modes can be stabilized only by a more tightly-fitting shell, plus reliance on finite-pressure effects on the small-major-radius side of the plasma profile. Under these conditions, stable configurations with peak beta values approaching unity are readily found.

29609 **(SAI—023-81-189-LJ) Simple fast routine for computation of energy transport by synchrotron radiation in tokamaks and similar geometries.** Tamor, S. (Science Applications, Inc., La Jolla, CA (USA). Lab. for Applied Plasma Studies). Jun 1981. Contract AC03-81ER53113. 29p. (LAPS—72). NTIS, PC A03/MF A01. Order Number DE81026333.

Calculation of energy transport by synchrotron radiation has long been considered as a difficult computational problem, largely due to the non-local nature of the transport which is aggravated by the presence of reflecting walls. We present here a simple physical model which mimics the main features of the transport. A computer code based upon this model is described and test calculations comparing its results to predictions of a full transport calculation are presented. Satisfactory agreement is found, both for the total energy loss and the radial profile of the power density.

29610 **(SAI—023-81-215LJ) Profile effects of synchrotron radiation in deuterium-fuelled tokamaks.** Baxter, D.C.; Tamor, S. (Science Applications, Inc., La Jolla, CA (USA). Lab. for Applied Plasma Studies). Jul 1981. Contract AC03-81ER53113. 14p. (LAPS—74). NTIS, PC A02/MF A01. Order Number DE81026332.

Calculations of temperature profile of D-fuelled tokamaks using the standard point models for synchrotron radiation and a new transport model are compared. It is shown that transport of radiation has a significant effect on the temperature profile, and that the sensitivity of the profile shape to the net transport loss is comparable to that for thermal conduction.

29611 **(SAI—254-81-103-LJ) Kinetic ballooning-interchange modes in tandem mirrors.** Lee, X.S.; Catto, P.J. (Science Applications, Inc., Boulder, CO (USA). Plasma Research Inst.). Mar 1981. Contract AC03-76ET53057. 22p. (PRI—24). NTIS, PC A02/MF A01. Order Number DE81027849.

A hybrid fluid-gyrokinetic derivation of the kinetic modifications to the ballooning-interchange eigenmode equation is presented which removes the large and small wave frequency restrictions of Tang and Catto. The derivation employs a long-thin ordering and an eikonal ansatz, but otherwise allows arbitrary asymmetry, beta, and pressure anisotropy.

29612 **(SAI—254-81-130-LJ) Equilibrium and stability of non-axisymmetric minimum-B mirrors.** D'Ippolito, D.A.; Freidberg, J.P. (Science Applications, Inc., Boulder, CO (USA). Plasma Research Inst.). Apr 1981. Contract AC03-76ET53057. 47p. (PRI—25). NTIS, PC A03/MF A01. Order Number DE81027442.

Analytic three-dimensional mirror equilibria are calculated from the tensor-pressure fluid equations by means of an asymptotic expansion procedure. The class of equilibria described here are relevant to the minimum-B end cells of current tandem mirror experiments. It is shown that in the shallow-well approximation, a small plasma pressure can produce a relative change of order unity in the vacuum magnetic well, thereby leading to interchange instability. In addition, if the axial dependence of the quadrupole field is not chosen in a specific way, finite-length corrections set an upper limit on the maximum allowable plasma radius. A simple prescription is given for this choice.

29613 **(SAI—254-81-155-LJ) Low-m ballooning stability of an axisymmetric sharp-boundary tandem mirror.** D'Ippolito, D.A.; Hafizi, B. (Science Applications, Inc., Boulder, CO (USA). Plasma Research Inst.). May 1981. Contract AC03-76ET53057. 30p. (PRI—26). NTIS, PC A03/MF A01. Order Number DE81027284.

A simple model of an axisymmetric tandem mirror is employed to study the stability of global (low-m) ballooning modes in the central cell. The presence of a perfectly conducting wall in the model gives an estimate of the effect of wall stabilization. The scaling of the critical β (= $2p/B^2$) with mode number m, connection length L/sub c/ to the end plug, and wall position w is computed for several magnetic field profiles.

29614 **(SAI—254-81-156-LJ) High-m ballooning stability of an axisymmetric E-ring-stabilized tandem mirror.** D'Ippolito, D.A.; Myra, J.R.; Ogden, J.M. (Science Applications, Inc., Boulder, CO (USA). Plasma Research Inst.). Jun 1981. Contract AC03-76ET53057. 57p. (PRI—27). NTIS, PC A04/MF A01. Order Number DE81027271.

A paraxial (long-thin) model of an electron-ring-stabilized tandem mirror is described. The model is applied to study the high-m (azimuthal mode number) stability of this axisymmetric configuration to interchange-ballooning modes within the rigid ring approximation. Stability boundaries are computed for two ring profiles and the results compared with earlier analytic calculations.

29615 (SAI—254-81-184-LJ) Nonlinear interaction of high-frequency, density-gradient-driven instabilities in mirror machines, II: saturation of the lower-hybrid-drift instability. Diamond, P.H.; Myra, J.R. (Science Applications, Inc., Boulder, CO (USA). Plasma Research Inst.). Jun 1981. Contract AC03-76ET53057. 34p. (PRI—28). NTIS, PC A03/MF A01. Order Number DE81027270.

A renormalized, energy conserving theory of low frequency, finite Larmor radius turbulence is applied to the determination of the nonlinear electron response to the low-hybrid-drift instability. The theory predicts saturation of the short wavelength modes by a Compton scattering induced cascade to long wavelengths. The saturation amplitude is in reasonable agreement with the turbulence level needed for suppression of the drift cyclotron mode.

29616 (SAI—254-81-201-LJ) Electron radial transport in tandem mirrors in the low-collision-frequency limit. Myra, J.R.; Catto, P.J.; Hazeltine, R.D. (Science Applications, Inc., Boulder, CO (USA). Plasma Research Inst.). Jun 1981. Contract AC03-76ET53057. 39p. (PRI—29). NTIS, PC A03/MF A01. Order Number DE81027851.

A variational principle formulation is used to calculate the electron radial transport coefficients in a nonaxisymmetric tandem mirror, in the low collisionality regime. Explicit analytical estimates are given for two important classes of electrons. The implications of symmetry, end currents, and ambipolarity are discussed in detail in order to demonstrate their potentially important effect on the radial particle loss rate.

29617 (SAI—254-81-0381-LJ) Nonlinear interaction of high-frequency density-gradient-driven modes in mirror machines. I. Suppression of the drift-cyclotron instability by lower-hybrid-drift turbulence. Diamond, P.H.; Myra, J.R.; Aamodt, R.E. (Science Applications, Inc., Boulder, CO (USA). Plasma Research Inst.). Oct 1980. Contract AC03-76ET53057. 31p. NTIS, PC A03/MF A01. Order Number DE81027850.

The nonlinear interaction of the drift cyclotron and lower-hybrid-drift modes is examined. A renormalized equation for the drift cyclotron ion response is derived and solved. Lower-hybrid-drift modes comprise the turbulent background. For levels of lower-hybrid-drift turbulence of e phi/T/sub i/ ~ (m/sub e//m/sub i/)/sup 1/2/(rho/sub i//L)/sup 3/4/, the growth rate of the drift cyclotron mode is drastically reduced by ion cyclotron resonance broadening, which is the dominant nonlinear effect.

29618 (UCID—19094) Status of TMX upgrade diagnostics construction. Hornady, R.S.; Davis, J.C.; Simonen, T.C. (Lawrence Livermore National Lab., CA (USA)). 20 Jul 1981. Contract W-7405-ENG-48. 54p. NTIS, PC A04/MF A01. Order Number DE81027079.

This report describes the status of the initial TMX Upgrade diagnostics and the state of development of additional diagnostics being prepared for later TMX Upgrade experiments. The initial diagnostic instrument set has been described in the TMX Upgrade Proposal. This set is required to get TMX Upgrade operational and to evaluate its initial performance. Additional diagnostic instruments are needed to then carry out the more detailed experiments outlined by the TMX Upgrade program milestones. The relation of these new measurements to the physics program is described in The TMX Upgrade Program Plan.

29619 (UCRL—53166) Computational investigation of the limits to Pease-Braginskii collapse of a Z-pinch. Nielsen, P.D. (Lawrence Livermore National Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 177p. NTIS, PC A09/MF A01. Order Number DE81028787.

Thesis.

This dissertation investigates the one-dimensional limits to such a radiation enhanced collapse through the use of a Lagrangian simulation code, LASNEX. The code includes the effects of a wide range of phenomena - opacity, ionization, experimentally determined equations of state, magnetic effects on transport coefficients, and external electrical circuits. Special attention was given to the magnetic field subroutines. They were revised to include ion acoustic and lower hybrid drift induced resistivity and to increase accuracy and efficiency. The magnetic pressure term was differenced in a manner that eliminates any influence of zone size, allowing large, low density zones outside the plasma column. In these large zones, magnetic flux and energy were determined by direct integration instead of summation to increase overall conservation. With these changes, the computational timesteps were determined by phenomena in the plasma instead of the Alfven velocity in the low density region. These modifications improved the accuracy of the code on Z-pinch problems by a factor of 10-100 depending on the minimum pinch radius reached.

29620 (UCRL—84854) Stimulated Raman scattering in large plasmas. Phillion, D.W.; Banner, D.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Nov 1980. Contract W-7405-ENG-48. 45p. (CONF-801119—7). NTIS, PC A03/MF A01. Order Number DE81026589.

From 22. annual meeting of the division of plasma physics of the APS; San Diego, CA, USA (10 Nov 1980).

Stimulated Raman scattering is of concern to laser fusion since it can create a hot electron environment which can increase the difficulty of achieving high final fuel densities. In earlier experiments with one micron laser light, the energy measured in Raman-scattered light has been insignificant. But these experiments were done with, at most, about 100 joules of laser energy. The Raman instability has a high threshold which also requires a large plasma to be irradiated with a large diameter spot. Only with a long interaction length can the Raman-scattered light wave convectively grow to a large amplitude, and only in recent long pulse, high energy experiments (4000 joules in 2 ns) at the Shiva laser facility have we observed as much as several percent of the laser light to be Raman-scattered. We find that the Raman instability has a much lower intensity threshold for longer laser pulselength and larger laser spot size on a solid target.

29621 (UCRL—85227) Electron cyclotron heating in TMX-Upgrade. Stallard, B.W.; Hooper, E.B. Jr. (California Univ., Berkeley (USA); Lawrence Livermore National Lab., CA (USA)). 1981. Contract W-7405-ENG-48. 6p. (CONF-810214—6). NTIS, PC A02/MF A01. Order Number DE81026647.

From 4. topical conference on radio frequency plasma heating; Austin, TX, USA (9 Feb 1981).

TMX-Upgrade, an improved tandem mirror experiment under construction at LLNL, will use electron cyclotron resonance heating (ECRH) to create thermal barriers and to increase the center cell ion confining potential. Gyrotron oscillators (200 kW, 28 GHz) supply the heating power for the potential confined electron (fundamental heating) and the mirror-confined electrons (harmonic heating) in the thermal barriers. Important issues are temperature limitation and microstability for the hot electrons. Off-midplane heating can control anisotropy-driven microstability. Spacially restricting heating offers the possibility of temperature control by limiting the energy for resonant interaction.

29622 (UCRL—85883) Plasma confinement in the TMX tandem mirror. Hooper, E.B. Jr.; Allen, S.L.; Casper, T.A. (Lawrence Livermore National Lab., CA (USA)). 29 Apr 1981. Contract W-7405-ENG-48. 5p. (CONF-810906—2). NTIS, PC A02/MF A01.

From 10. European conference on controlled fusion and plasma physics; Moscow, USSR (14 Sep 1981).

Plasma confinement in the Tandem Mirror Experiment (TMX) is described. Axially confining potentials are shown to exist throughout the central 20-cm core of TMX. Axial electron-confinement time is up to 100 times that of single-cell mirror machines. Radial transport of ions is smaller than axial transport near the axis. It has two parts at large radii: nonambipolar, in rough agreement with predictions from resonant-neoclassical transport theory, and ambipolar, observed near the plasma edge under certain conditions, accompanied by a low-frequency, m = 1 instability or strong turbulence.

29623 (UCRL—85970) Production and loss of H^- and D^- in the volume of a plasma. Hamilton, G.W.; Bacal, M. (Lawrence Livermore National Lab., CA (USA); Ecole Polytechnique, 75 - Paris (France). Lab. de Physique des Milieux Ionises). 1 Jul 1981. Contract W-7405-ENG-48. 10p. (CONF-810729—1). NTIS, PC A02/MF A01. Order Number DE81025633.

From 15. international conference on phenomena in ionized gases; Minsk, USSR (14 Jul 1981).

The study of the production and loss of negative ions, H^- and D^-, in the volume of a plasma has received considerable attention since the measurement of anomalously high densities of H^- in 1977. The most probable mechanism for production is dissociative attachment (DA) to vibrationally highly-excited hydrogen molecules. New diagnostics developed for this purpose are photodetachment and the extension of coherent anti-Stokes Raman scattering (CARS) systems to the sensitivity required for low-pressure gases. Measurements and calculations indicate that the important loss mechanisms are diffusion to the walls at low densities and collisional destruction of several types at plasma densities above 10^{10} cm^{-3}. Production mechanisms must be highly efficient to compete with the losses. It appears to be straightforward to extrapolate measurements and theory to the densities above 10^{12} cm^{-3} that are required for an intense source of D^- for neutral beam injection into magnetically-confined fusion devices.

29624 Heating of a dense plasma using an intense, relativistic electron beam. Montgomery, M.D.; Parker, J.V.; Riepe, K.B.; Sheffield, R.L. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). W-7405-ENG.36. *Applied Physics Letters ;* **39**: No. 3, 217-219(1 Aug 1981).

We report observations of heating of a dense ($\sim 10^{17}$ cm^{-3}) plasma using a 3-MeV electron beam with a current density of 5 x 10^5 A/cm^2. The measured, strong dependence of heating on beam transverse temperature and the short saturation distance (<4 cm) are evidence that the beam-to-plasma energy transfer takes place via a fast growing microinstability such as the relativistic electron-electron two stream.

29625 Variational moment solutions to the Grad—Shafranov equation. Lao, L.L.; Hirshman, S.P.; Wieland, R.M. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Physics of Fluids ;* **24**: No. 8, 1431-1440(Aug 1981).

A variational method is developed to find approximate solutions to the Grad—Shafranov equation. The surfaces of the constant poloidal magnetic flux psi(R, Z) are obtained by solving a few ordinary differential equations, which are moments of the Grad—Shafranov equation, for the Fourier amplitudes of the inverse mapping R(psi, θ) and Z(psi, θ). Analytic properties and solutions of the moment equations are considered. Specific calculations using the Impurity Study Experiment (ISX-B) and the Engineering Test Facility (ETF)/International Tokamak Reactor (INTOR) geometries are performed numerically, and the results agree well with those calculated using standard two-dimensional equilibrium codes. The main advantage of the variational moment method is that it significantly reduces the computational time required to determine two-dimensional equilibria without sacrificing accuracy.

29626 Appendix: Variational moment solutions to the Grad—Shafranov equation [Phys. Fluid 24, 1440 (1981)]. Weitzner, H. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). W-7405-ENG-26. *Physics of Fluids ;* **24**: No. 8, 1440-1441(Aug 1981).

Appendix to Variational moment solutions to the Grad—Shafranov equation (AIP)

29627 Thermal heat flux in a plasma for arbitrary collisionality. Khan, S.A.; Rognlien, T.D. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). W-7405-ENG-48. *Physics of Fluids ;* **24**: No. 8, 1442-1446(Aug 1981).

The thermal heat flux along a uniform magnetic field due to a temperature gradient is calculated using a Monte Carlo solution to the Fokker—Planck equation. This numerical solution, which is computed for a particular electron temperature profile, is valid for arbitrary mean-free-path, λ/sub mfp/. The calculated heat flux makes a smooth transition between the analytic expressions for the short and long λ/sub mfp/ limits.

29628 Variational principle for low-frequency stability of collisionless plasmas. Antonsen, T.M. Jr.; Lane, B.; Ramos, J.J. (Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). E-AC02-78ET53073.A002. *Physics of Fluids ;* **24**: No. 8, 1465-1473(Aug 1981).

An analysis of the stability of an arbitrary β collisionless plasma to modes with wavelengths greater than the ion gyroradius is presented. The stability of such a plasma to perturbations that grow on the hydrodynamic time scale is determined by the Kruskal—Oberman energy principle. However, a configuration which is predicted to be stable on the basis of this kinetic energy principle may still be unstable to modes that grow with a frequency comparable to the diamagnetic or curvature drift frequency. A new variational principle that gives sufficient conditions for instability of these low- frequency modes is derived. The new principle indicates that two types of instabilities are possible; the first corresponds to the low-frequency electrostatic, trapped particles mode, and the second is the low-frequency limit of magnetohydrodynamic (interchange and ballooning) modes. The kinetic modifications to the interchange (Mercier) criterion are evaluated and the effect of the kinetic terms on ballooning modes is estimated.

29629 Theory and simulation of stimulated Brillouin scatter excited by nonabsorbed light in laser fusion systems. Randall, C.J.; Albritton, J.R.; Thomson, J.J. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physics of Fluids ;* **24**: No. 8, 1474-1484(Aug 1981).

The noise spectrum from which stimulated Brillouin scatter grows has two sources in laser fusion plasmas; a broadband source due to ion-acoustic fluctuations, and a line source, usually much larger, which is the nonabsorbed light returning from the plasma critical surface. We give a theoretical description of stimulated Brillouin backscatter when the fluctuation source may be neglected and the scatter grows exclusively from the nonabsorbed light. Gradients of background density, velocity, and temperature are allowed. Theoretical predictions are compared to numerical simulations of scatter for parameters of recent experiments. It is found that stimulated Brillouin scatter can be greatly enhanced by the presence of a critical surface and that it can become an important part of the total energy balance.

29630 Integral-equation formulation for drift eigenmodes in cylindrically symmetric systems. Linsker, R. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Physics of Fluids ;* **24**: No. 8, 1485-1491(Aug 1981).

A method for solving the integral eigenmode equation for drift waves in cylindrical (or slab) geometry is presented. A leading-order kinematic effect that has been noted in the past, but incorrectly ignored in recent integral-equation calculations, is incorporated. The present method also allows electrons to be treated with a physical mass ratio (unlike earlier work that is restricted to artificially small m/sub i//m/sub e/ owing to resolution limitations). Results for the universal mode and for the ion-temperature-gradient driven mode are presented. The kinematic effect qualitatively changes the spectrum of the ion mode, and a new "second region of instability" for k/sub perpendicular/ rho/sub i/> or ≈1 is found.

29631 Destabilitization of low mode number Alfven modes in a tokamak by energetic or alpha particles. Tsang, K.T.; Sigmar, D.J.; Whitson, J.C. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Physics of Fluids ;* **24**: No. 8, 1508-1516(Aug 1981).

With the inclusion of finite Larmor radius effects in the shear Alfven eigenmode equation, the continuous Alfven spectrum, which has been extensively discussed in ideal magnetohydrodnamics, is removed. Neutrally stable, discrete radial eignmodes appear in the absence of sources of free energy dand dissipation. Alpha (or energetic) particle toroidal drifts destabilize these modes, provided

the particles are faster than the Alfven speed. Although the electron Landau resonance contributes to damping, a stability study of the parametric variation of the energy and the density scale length of the energetic particles shows that modes with low radial mode numbers remain unstable in most cases. Since the alpha particles are concentrated in the center of the plasma, this drift-type instability suggests anomalous helium ash diffusion. Indeed, it is shown that stochasticity of alpha orbits due to the overlapping of radially neighboring Alfven resonances is induced at low amplitudes, e/sub i/phi/T/sub i/> or $\approx$0.05, implying a diffusion coefficient D/sub r//sup α/> or $\approx$4.4 x 10^3 cm^2/sec.

29632 **Stability of colliding ion beams.** Foote, E.A.; Kulsrud, R.M. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). DE-AC02-76-CH03073. *Physics of Fluids ;* **24**: No. 8, 1532-1540(Aug 1981).

Conditions are determined for the stability of two identical colliding ion beams in the presence of neutralizing electrons, but no background ions. Such a situation is envisioned for the Counter-streaming Ion Torus. The ion beams are taken to be Maxwellian in their frames of reference. The approximation of decoupled electrostatic and electromagnetic modes is made. The stability of the electrostatic modes depends on the relation between the ion-electron temperature ratio and the relative beam velocities. The stability of the electromagnetic mode depends on the relation between the ion plasma β and the relative beam velocities.

29633 **Diffusion on two length scales.** Cohen, R.H.; Nevins, W.M.; Rowlands, G. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physics of Fluids ;* **24**: No. 8, 1584-1585(Aug 1981).

One-dimensional diffusion is considered for a system in which the diffusion coefficient D has a rapid oscillation in the spatial variable as well as a slow variation. For long times, the distribution function evolves diffusively with an effective diffusion coefficient given by averaging 1/D.

29634 **Lower hybrid density drift instability with magnetic curvature.** Rahal, L.J.; Gary, S.P. (Los Alamos Technical Associates, Los Alamos, New Mexico 87544). *Physics of Fluids ;* **24**: No. 8, 1588-1589(Aug 1981).

The linear Vlasov theory of electrostatic drift instabilities is considered using the slab model and the local approximation. The effects of magnetic field curvature on the lower hybrid density drift instability are studied. Magnetic curvature does not significantly affect the growth rate at low beta.

29635 **Reconnection phenomena during the formation phase of field-reversal experiments.** Hewett, D.W.; Seyler, C.E. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters ;* **46**: No. 23, 1519-1522(8 Jun 1981).

The results of hybrid simulations of the formation and the evolution to equilibrium of field-reversal experiment (FRX) configurations are presented. The observed rapid reconnection is explained in terms of forced reconnection driven by a Kruskal-Schwarzschild instability and the self-consistent production of toroidal magnetic field.

29636 **Magnetic trapped-particle modes.** Rosenbluth, M.N. (Institute for Fusion Studies, University of Texas, Austin, Texas 78712). DE-FG05-80ET-53088. *Physical Review Letters ;* **46**: No. 23, 1525-1528(8 Jun 1981).

It is shown that very-low-frequency magnetic modes may be unstable for systems such as tandem mirrors which contain plasma trapped in regions of unfavorable curvature. Onset of the instability occurs when the diamagnetic plasma pressure is sufficient to reverse particle drift velocities.

29637 **Lower hybrid density first instability with cold plasma.** Gary, S.P.; Ashour-Abdalla, M. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Journal of Geophysical Research ;* **86**: No. A3, 1613-1616(1 Mar 1981).

The linear Vlasov dispersion relation for the lower hybrid density drift instability is studied in a four component (hot electrons and protons, cold electrons and protons) plasma. The introduction of a cold ion population monotonically reduces the maximum rate of the instability. Reduction of T/sub c//T/sub h/, the ratio of temperatures of the cold and hot plasmas, reduces both the real frequency and the growth rate of the intensity. Near T/sub c//T/sub h/ = 10^{-2} a higher frequency branch of this instability emerges and for fixed n/sub c//n/sub h/ exhibits an increasing maximum growth rate as T/sub c//T/sub h/ decreases further. The ratio T/sub c//T/sub h/ for the ions is the crucial parameter and deserves detailed magnetospheric studies.

29638 **Experimental investigation of an impurity-driven drift-wave instability.** Allen, G.R. Princeton, NJ; Princeton Univ. (1981). 82p. University Microfilms Order No. 81-11,274.

Thesis (Ph. D.).

An impurity-driven drift-wave instability is observed to be destabilized by the reversed density gradient of a heavy, singly-ionized impurity-ion population in a Q-machine plasma. The dispersion relation is derived from the Vlasov equation, including collisions, in the velocity range v/sub i/ < v/sub i/ < ω/k/sub z/ much less than v/sub e/. The dependences of frequencies and growth rates upon azimuthal mode number, magnetic field, and impurity fraction are all in good agreement with the local, linear, slab-model dispersion relation. By pulsing the impurity-ion injection, the evolution of the instability is investigated through the linear exponential growth phase, into nonlinear saturation, whereupon strong, radially outward anomalous diffusion is driven by a wave-particle interaction.

29639 **(SAI—254-80-656-LJ-Vol.1) Magnetic fusion energy program. Annual report.** Aamodt, R.E.; Catto, P.J.; D'Ippolito, D.A. (Science Applications, Inc., Boulder, CO (USA). Plasma Research Inst.). Dec 1980. Contract AC03-76ET53057. 261p. (PRI—20-Vol.1). NTIS, PC A12/MF A01.

This report is primarily composed of eleven appendices dealing mainly with theoretical studies of instabilities in magnetic mirror configurations. Abstracts were prepared for each. (MOW)

29640 (SAI—254-80-656-LJ-Vol.1, pp 17-28) **Analytic equilibrium and stability studies of the tandem mirror.** Freidberg, J.P.; D'Ippolito, D.A. Dec 1980. NTIS, PC A12/MF A01.

In Magnetic fusion energy program. Annual report.

We have constructed an analytic equilbrium model of a non-axisymmetric tandem mirror without a thermal barrier. For the minimum-B end cell, a three-dimensional tensor-pressure equilibrium solution is obtained by means of an expansion in four small parameters: β = 2P/B^2, λ = a/L, and the amplitudes Δ/sub B/ and Δ/sub E/ of the bumpy and the elliptical contributions to the magnetic field. A maximal ordering is chosen such that a magnetic well can be constructed to obtain interchange stability, and yet the ballooning instability is retained in the ordering. For the central solenoid and transition region, a tensor-pressure axisymmetric equilibrium solution is used, since the deviations from axisymmetry are unimportant in the limit of large mirror ratio. By matching the two equilibrium solutions, one obtains an analytic model suitable for ballooning mode stability studies. Preliminary stability results will be reported.

29641 (SAI—254-80-656-LJ-Vol.1, pp 29-46) **Omnigenity.** Hazeltine, R.D.; Catto, P.J. Dec 1980. NTIS, PC A12/MF A01.

In Magnetic fusion energy program. Annual report.

Classical transport in a magnetized plasma is insensitive to the field configuration because Larmor gyration yields a geometry-independent departure of charged particles from field lines. Neoclassical transport, on the other hand, although typically much larger, depends upon guiding center excursions from flux surfaces. In omnigenous systems, all particles on a given field line drift in the same surface and neoclassical effects are absent. A general investigation of curvature and gradient-B drifts, for arbitrary asymmetry and collisionality, reveals a simple criterion for omnigenity. The criterion is obtained without recourse to the second adiabatic invar-

iant. At least in the scalar pressure case, any finite-beta confining field whose parallel current, $B^{-2}(J.B)B$ has zero divergence, is rigorously omnigenous. In particular, nearly omnigenous equilibria seem accessible to a number of confinement concepts in which the parallel current can be kept small.

29642 (SAI—254-80-656-LJ-Vol.1, pp 47-65E) **Strongly-localized ballooning modes in a tandem mirror.** D'Ippolito, D.A.; Myra, J.R. Dec 1980. NTIS, PC A12/MF A01.

In Magnetic fusion energy program. Annual report.

A simple model of a tandem mirror without thermal barriers is employed to study the stability of ballooning modes which are confined to the central mirror cell. The central cell is treated as axisymmetric and long-thin with isotropic pressure, while the end plug is modeled by a stabilizing boundary condition. The scaling of β/sub c/ with the mirror ratio, R*, and the connection length, L/sub c/, is computed, and the sensitivity of these results to the magnetic field profile chosen is discussed.

29643 (SAI—254-80-656-LJ-Vol.1, pp 66-87) **High-n ballooning stability of an axisymmetric tandem mirror.** D'Ippolito, D.A.; Myra, J.R.; Ogden, J.M. Dec 1980. NTIS, PC A12/MF A01.

In Magnetic fusion energy program. Annual report.

We have studied the high-n (azimuthal mode number) ballooning stability of an axisymmetric tandem mirror without thermal barriers. In this configuration, a long central solenoid is bounded on each end by a mirror cell containing a relativistic electron ring or disk. If the ring is rigid (noninteracting) on the MHD time scale, the magnetic well created by it will serve as an MHD anchor for interchange and ballooning modes. The plasma β(= plasma pressure/magnetic pressure) is then limited by ballooning modes localized in the bad-curvature transition region between the central cell and the end plug. Using analytic and numerical finite-β equilibrium models of this configuration, we have studied the dependence of the critical beta in the central cell on the ring beta, the mirror ratio, and on various geometrical parameters characterizing the end plug and transition region.

29644 (SAI—254-80-656-LJ-Vol.1, pp 88-110) **Kinetic effects on ballooning modes in tandem mirrors.** Tang, W.M. Dec 1980. NTIS, PC A12/MF A01.

In Magnetic fusion energy program. Annual report.

In the tandem mirror, currently the most strongly supported type of mirror experiment, theoretical estimates of the maximum achievable beta (plasma pressure/magnetic pressure) are based on the onset conditions for the MHD ballooning instability. Since these perturbations are characterized by short wavelengths perpendicular to the magnetic field and long parallel wavelengths, the eikonal representation is a natural choice and effectively reduces the problem to a radially local, one-dimensional eigenmode analysis. MHD studies of this problem have indicated that the most dangerous form of these modes occur for large azimuthal mode numbers. This is just the region where kinetic modifications due, for example, to finite gyroradius effects could prove to be significant. To study this problem it is necessary to derive the governing kinetic ballooning mode equation for a nonaxisymmetric, arbitrary beta system with anisotropic pressure. This derivation is presented for a long-thin equilibrium typical of the tandem mirror, and the implications of the kinetic modifications will be discussed.

29645 (SAI—254-80-656-LJ-Vol.1, pp 111-131) **Generalized gyrokinetics.** Catto, P.J.; Tang, W.M.; Baldwin, D.E. Dec 1980. NTIS, PC A12/MF A01.

In Magnetic fusion energy program. Annual report.

By retaining the magnetic moment μ to higher order in the gryoradius over scale length expansion and employing a gyrokinetic change of variables a full finite beta derivation of the gyrokinetic equation is presented within the eikonal ansatz for arbitrary magnetic fields and μ dependent unperturbed distribution functions.

29646 (SAI—254-80-656-LJ-Vol.1, pp 132-146) **Finite-Larmor-radius stabilization of ballooning modes in an axisymmetric tandem mirror.** D'Ippolito, D.A.; Francis, G.L.; Myra, J.R.; Tang, W.M. Dec 1980. NTIS, PC A12/MF A01.

In Magnetic fusion energy program. Annual report.

The stability of an axisymmetric tandem mirror to ballooning modes is examined including the effect of finite ion gyroradius stabilization. The central cell of the tandem mirror is treated as a long-thin system with isotropic pressure, while the end plug is modeled by a stabilizing boundary condition. For the particular equilibrium considered, the finite-Larmor radius corrections to the ideal magnetohydrodynamic theory indicate a strong stabilizing effect on high-n ballooning modes even for quite modest values of gyroradius, k/sub perpendicular to/rho/sub i/ $\sim$ a/L $<<$ 1. The dependence of β/sub c/ on k/sub perpendicular to/rho/sub i/ is computed, and possible physical mechanisms associated with this stabilizing influence are discussed.

29647 (SAI—254-80-656-LJ-Vol.1, pp 148-185) **Lower-hybrid-drift instability with axis encircling ions.** Myra, J.R.; Catto, P.J.; Aamodt, R.E. Dec 1980. NTIS, PC A12/MF A01.

In Magnetic fusion energy program. Annual report.

The stability of a cylindrical plasma to electrostatic flute perturbations in the ion-cyclotron to lower-hybrid frequency range is considered. The analysis exploits the large growth rates of these modes to reduce the governing radial eigenvalue problem from an integral equation to a second order differential equation, but allows treatment of arbitrary ion Larmor radius to plasma radius. The fastest growing modes of the ion guiding-center-on-axis model are shown to connect onto the lower-hybrid-drift modes of local slab theory. Numerical and analytical results for growth rates and most unstable mode numbers are obtained.

29648 (SAI—254-80-656-LJ-Vol.1, pp 186-196) **Nonlinear saturation of the lower-hybrid drift instability.** Myra, J.R.; Aamodt, R.E. Dec 1980. NTIS, PC A12/MF A01.

In Magnetic fusion energy program. Annual report.

The nonlinear evolution of the lower-hybrid-drift instability is considered in the guiding-centers-on-axis model. Extremely rapid radial quasilinear diffusion of electrons leads to the buildup of a radial electric field, vector E/sub r/. Saturation occurs when the vector E/sub r/ x vector B electron drift velocity equals the local ion rotational velocity. Due to the rapid linear growth rate, the unmagnetized ions here are unable to shield out vector E/sub r/, which becomes significant long before density profile flattening occurs.

29649 (SAI—254-80-656-LJ-Vol.1, pp 197-218) **Nonlinear interaction of density gradient driven modes in mirror machines.** Myra, J.R.; Diamond, P.H.; Aamodt, R.E. Dec 1980. NTIS, PC A12/MF A01.

In Magnetic fusion energy program. Annual report.

The nonlinear interaction of a single drift cyclotron (DC) mode with a turbulent spectrum of lower hybrid drift (LHD) modes in slab geometry is examined. A renormalized equation for the DC ion response in the presence of the LHD spectrum has been derived and solved. Results indicate that the dominant nonlinear effect is cyclotron resonance broadening due to orbit scattering by LHD modes and that typically an LHD amplitude of ephi/T/sub i/ $\sim$ m/sub e/m/sub i/ is sufficient to stabilize the DC mode. Self-consistent saturation mechanisms for the LHD modes and possible coupling of DC and LHD modes in the saturated state are being investigated.

29650 (SAI—254-80-656-LJ-Vol.1, pp 232-252) **Collisional end losses from conventional and tandem mirrors.** Catto, P.J.; Bernstein, I.B. Dec 1980. NTIS, PC A12/MF A01.

In Magnetic fusion energy program. Annual report.

A simple variational procedure is employed to obtain an analytic expression for the collisional particle end loss rate in a mirror for the electrostatically confined species. The technique circumvents the need for an accurate solution for the distribution function, and yet reproduces the previous large mirror ratio, large barrier height results for the loss rate. The analytic result is also in remarkably good agreement with a numerical solution of the full linearized Fokker-Planck equation.

29651 **(SAI—254-80-656-LJ-Vol.2) Magnetic fusion energy program. Annual report.** Aamodt, R.E.; Catto, P.J.; D'Ippolito, D.A. (Science Applications, Inc., Boulder, CO (USA). Plasma Research Inst.). Dec 1980. Contract AC03-76ET53057. 265p. (PRI—20-Vol.2). NTIS, PC A12/MF A01.

Separate abstracts were prepared for the 5 included appendices. (MOW)

29652 (SAI—254-80-656-LJ-Vol.2, pp 253-339) **Relativistic theory of electron cyclotron resonance heating.** Bernstein, I.B.; Baxter, D.C. Dec 1980. NTIS, PC A12/MF A01.

In Magnetic fusion energy program. Annual report.

The formal theory of the interaction of mildly relativistic electrons with a cyclotron resonant applied electromagnetic field described by geometric optics is developed. The electron distribution function is written as the sum of a quasi-static part f_0 and a high frequency part f_1. A quasi-linear theory is employed to describe these. The resulting transport equation f_0 is written to lowest significant order jointly in the reciprocal of the gyration frequency and the bounce frequency. It includes a relativistic collision term and a drag term associated with synchrotron emission. The linearized equations for f_1 are solved and an expression for the high frequency current derived.

29653 (SAI—254-80-656-LJ-Vol.2, pp 340-411) **Bumpy torus transport in the low collision frequency limit.** Hazeltine, R.D.; Catto, P.J. Dec 1980. NTIS, PC A12/MF A01.

In Magnetic fusion energy program. Annual report.

A variational formulation of transport for a closed field line, large aspect ratio bumpy torus in the low collision frequency limit is presented. The relatively large radial excursions made by those particles with canceling magnetic and electric poloidal drifts requires generalization of previous neoclassical techniques. General expressions for the transport coefficients of both charge species are given. Explicit numerical coefficients are evaluated under certain simplifying assumptions for both the banana and non-banana species.

29654 (SAI—254-80-656-LJ-Vol.2, pp 412-464) **Trapped electron modifications to tearing modes in the low collision frequency limit.** Catto, P.J.; Rosenbluth, M.N. Dec 1980. NTIS, PC A12/MF A01.

In Magnetic fusion energy program. Annual report.

In the limit of weak collisions a narrow boundary layer forms at the trapped/untrapped boundary in velocity space. When the electron collision frequency ν/sub e/ is small compared to the wave frequency ω times the inverse aspect ratio ϵ, a realistic collision operator must be employed to evaluate the response of the boundary layer electrons. The parallel current carried by the barely circulating boundary layer electrons results in tearing mode modifications which are evaluated from a slab model in the banana regime (ν/sub e/ $< \epsilon\omega$) by using a Lorentz model collision operator.

29655 (SAI—254-80-656-LJ-Vol.2, pp 465-499) **Mode coupling in a toroidal, sharp-boundary plasma I. Weak-coupling limit.** D'Ippolito, D.A.; Goedbloed, J.P. Dec 1980. NTIS, PC A12/MF A01.

In Magnetic fusion energy program. Annual report.

The phenomenon of mode coupling in the discrete Alfven wave spectrum of ideal magnetohydrodynamics is studied using a simplified plasma model. It is shown that mode coupling occurs when a periodic modulation of the equilibrium magnetic field strength and curvature is introduced, either by toroidicity spectrum and the sparial localization of the eigenfunction or by noncircularity of the cross section. The existence of gaps in the frequency as a result of mode coupling is analogous to the behavior of valence electrons in a one-dimensional crystal lattice.

29656 (SAI—254-80-656-LJ-Vol.2, pp 500-506) **Novel features of FRX equilibria.** Byrne, R.N. Dec 1980. NTIS, PC A12/MF A01.

In Magnetic fusion energy program. Annual report.

The FRX device at Los Alamos is a long reversed field theta pinch, a special form of compact torus. Using the conventional formalism of 1 1/2 D equilibria to disucss the problem, we find some novel features. Computations have verified what intuition tells us about the FRX: because of its great aspect ratio, there exists a region of the device for which a simple 1D (cylindrical) treatment is appropriate.

29657 **Fundamental resonance ion cyclotron heating in the Phaedrus plug mirrors.** Smith, D.K. Madison, WI; Univ. of Wisconsin (1980). 100p. University Microfilms Order No. 81-06,531.

Thesis (Ph. D.).

A series of experiments have been performed using ion cyclotron resonance heating (ICRH) at the fundamental cyclotron resonance in the plug mirrors of the Phaedrus Tandem Mirror at the University of Wisconsin. The results of these experiments and an analysis of the results are presented in this thesis. The important role which ICRH may play in tandem mirror development and the consequent need for an experimental test have motivated this research. By coupling up to 50 kW of 3 MHz RF power to the plug plasma the average ion energy was increased from approximately 100 eV to 700 to 1000 eV. Associated effects on electron temperature and particle confinement were also observed. The ion heating was found to be consistent with previously developed theoretical descriptions of field penetration and stochastic heating.

29658 **(DOE/ET/53053—T1) Theoretical and numerical studies in magnetic minor fusion. Annual technical progress report.** Bernstein, I.B.; Schultz, M.H. (Yale Univ., New Haven, CT (USA)). [nd]. Contract AS02-77ET53053. 5p. NTIS, PC A02/MF A01. Order Number DE81025970.

Summaries of work completed during this period are given for the following: (1) geometric optics, (2) particle losses from deep traps, (3) Fokker-Planck codes, and (4) action-angle variables and transport. (MOW)

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REFER ALSO TO CITATION(S) 28953, 28954, 28955, 28956, 28957, 28958, 28964, 28965, 28966, 28967, 28968, 28969, 28970, 28971, 28972, 28973, 28974, 28975, 28976, 28980, 28981, 28982, 28983, 28990, 29005, 29008, 29009, 29010, 29011, 29012, 29013, 29014, 29141, 29142, 29497, 29593, 29597, 29761

29659 **(BNL—29512) Heavy ion beam interaction and energy partition in the initial stages of ICF target irradiation.** Suh, P.; Makowitz, H.; Stauber, M.; Miley, G.H.; Harris, D. (Brookhaven National Lab., Upton, NY (USA); Grumman Aerospace Corp., Bethpage, NY (USA); Illinois Univ., Urbana (USA)). Nov 1980. Contract AC02-76CH00016. 30p. (CONF-810527—6). NTIS, PC A03/MF A01. Order Number DE81025296.

From International conference on plasma science; Sante Fe, NM, USA (18 May 1981).

An order of magnitude analysis of the effect of 20 GeV U-ion beam impact on an idealized ICF target, Be or Au ablator region has been made, and the beam interaction and energy partition have been studied for the initial stages of target irradiation. Uniform heating and an expansion preserving uniform density of the ablator medium was assumed for the initial stage of beam interaction. Significant differences in the partition of energy occur between Be and Au ablators. For Au, the main channels for the heavy-ion beam energy output are the escaping radiation energy (10 to 20% of the energy input, based on an extrapolation) and the thermal energy. For Be the ablator thermal energy and ionization channels dominate.

29660 **(CONF-810606—80) Preliminary activation calculations for the Poloidal Divertor Experiment.** Judd, J.L.; Scott, A.J.; Nigg, D.W.; Bohn, T.S. (EG and G Idaho, Inc., Idaho Falls (USA)). 1981. Contract AC07-76ID01570. 6p. NTIS, PC A02/MF A01. Order Number DE81026525.

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

The Poloidal Divertor Experiment (PDX) tokamak is being operated by the Princeton Plasma Physics Laboratory (PPPL) to study plasma cross section shaping, high power neutral beam heating, and divertor control of plasma impurities in tokamaks. Experiments to date have been performed at relatively low power, but

with 6 MW of neutral beam power eventually available, high D-D plasma reaction rates are expected that will yield up to 10^{15} 2.45-MeV neutrons per pulse. This neutron emission level is high enough to cause significant neutron-induced machine activation that will limit the occupancy time of personnel entering the room to repair or change parts. The dose rate depends on the location in the room and, of course, the pulsing history prior to entry. This paper describes one-dimensional activation calculations that have been done for PDX to provide preliminary dose rate information for various times after shutdown following one week of high power operation.

29661 **(CONF-810606—82) Source-to-incident-flux relation in a tokamak blanket module.** Imel, G.R. (EG and G Idaho, Inc., Idaho Falls (USA)). 1981. Contract AC07-76ID01570. 4p. NTIS, PC A02/MF A01. Order Number DE81026524.

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

The next-generation tokamak experiments, including the Tokamak Fusion Test Reactor (TFTR), will utilize small blanket modules to measure performance parameters such as tritium breeding profiles, power deposition profiles, and neutron flux profiles. Specifically, a neutron calorimeter (simply a neutron moderating blanket module) which allows one to infer the incident 14 MeV flux based on measured temperature profiles has been proposed for TFTR. The problem addressed here is how to relate this total scalar flux to the fusion neutron source; this relation is necessary since the calorimeter is proposed as a total fusion energy monitor. The methods and assumptions presented here will be valid for the TFTR Lithium Breeding Module (LBM), as well as other modules on larger tokamak reactors.

29662 **(CONF-810680—2) Plasma assessments for the fusion engineering device (FED).** Peng, Y.K.M.; Rutherford, P.H.; Lyon, J.F. (Oak Ridge National Lab., TN (USA); Princeton Univ., NJ (USA). Plasma Physics Lab.; Massachusetts Inst. of Tech., Cambridge (USA)). 1981. Contract W-7405-ENG-26. 13p. NTIS, PC A02/MF A01. Order Number DE81024254.

From Symposium on physics problems of fusion reactors; Trieste, Italy (2 Jun 1981).

An initial range of plasma assumptions and scenarios has been examined for the US tokamak FED concept. The results suggest that the current FED baseline parameters of R = 4.8 m, B/sub t/ = 3.6 T, a = 1.3 m, b = 2.1 m (D-shape), and I/sub p/ = 4.8 to 5.4 MA are appropriate for achieving its nominal goals of P(fusion) approx. = 180 MW and a plasma Q $\geqq$ to 5 for a pulse length greater than 100 s. However, large uncertainty still exists in the areas of current startup, ion-cyclotron wave launching, influence of plasma shape on achievable beta, impurity control, plasma edge transport, and plasma disruption. Various options and remedies have been suggested to alleviate the impact of the uncertainty on the FED design concept. They appear promising because they can be studied experimentally and are not expected to lead to fundamental design modifications of FED.

29663 **(CONF-810699—1) Engineering challenges of fusion-reactor development.** Talbot, J.B. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 10p. NTIS, PC A02/MF A01. Order Number DE81024129.

From Society of Women Engineers 1981 national convention; Anaheim, CA, USA (24 Jun 1981).

A brief review of the fusion research program and some problems to be faced in the near future are described. (MOW)

29664 **(CONF-8010203—1) ANL low beta development (Phase O).** Watson, J.M. (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG-38. 9p. NTIS, PC A02/MF A01. Order Number DE81023848.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1980).

The rf linac ADF is getting underway with a high brightness beam of 50 mA of Xe^{+1} at 1.3 MeV already available. The short independently-phased linac cavities are nearing completion and construction of the first Wideroee tank has begun. Because of the stringent current and emittance requirements, realistic computer simulations are needed for initial designs of the ADF as well as for understanding the performance of each section. The experimental measurements will require a new generation of diagnostics which will accurately characterize the beam without altering it or being destroyed by it. The low beta section of the ADF is a challenge, but now appears solvable with the proper mix of simulation and experimental measurements.

29665 **(CONF-8010203—2) Storage ring injection.** Burke, R.J. (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG-38. 11p. NTIS, PC A02/MF A01. Order Number DE81023846.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1980).

Some basic issues involved in injecting the beam into storage rings with the principal parameters of those studied at the workshop have been considered. The main conclusion is that straightforward adjustments of the storage ring parameters makes injection easy. The largest number of injected turns is fourteen, and the phase space dilution allowance seems adequate to ensure very small beam loss during injection. The adjustments also result in lower bending magnet fields, and high field superconducting magnets (e.g., 5 Tesla) are not necessary. The design changes do not necessarily affect the Keil-Schnell criterion for stability of the longitudinal microwave instability, although that criterion appears to be irrelevant. Because the beams are expected to be unstable, but with slow growth rates, the vacuum chamber impedances required to give equal risetimes for the various designs are compared for systems posing various degrees of difficulty for injection. Finally, the impact of the parameters on cost is noted, and a system is considered that cuts the length of the linac in half by using doubly charged ions.

29666 **(CONF-8010206—1) Heavy ion fusion program at Argonne.** Martin, R.L.; Arnold, R.; Burke, R.; Watson, J. (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG-38. 10p. NTIS, PC A02/MF A01. Order Number DE81023905.

From 7. all-union national conference on particle accelerators; Dubna, USSR (14 Oct 1980).

Argonne's Heavy Ion Fusion (HIF) program is trying for two major achievements during the coming 4 to 5 years. The primary objective is to demonstrate accelerator operation in areas that are especially important for the use of heavy ion accelerator systems as drivers in inertial fusion power plants. These demonstrations comprise reliable operation of a front end (source, preaccelerator, and rf linac to ~ 10 MeV) with adequate output beam current and emittance; tolerable emittance growth during further acceleration in an rf linac (including frequency transition, with simulated linac-beam combination, and intense beam stripping); strong debunching; multiturn injection with minimal beam loss and tolerable phase space dilution; beam compression; and efficient focusing. The second objective is to demonstrate efficient stopping of intense ion beams in material at conditions relevant to fusion pellet implosion. For this purpose, the apparatus of the primary (accelerator) demonstration would be modified to include a synchrotron accelerating the 220 MeV Xe^{+8} from the linac to 10 GeV.

29667 **(DOE/DP/40030—3) Inertial fusion research. Annual technical report, 1980.** (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1980. Contract AC08-78DP40030. 228p. NTIS, PC A11/MF A01. Order Number DE81026574.

Separate abstracts were prepared for each of the 4 included sections. (MOW)

29668 (DOE/DP/40030—3, pp 2.1-2.54) **Laser target experiments.** Slater, D.C. 1980. NTIS, PC A11/MF A01.

In Inertial fusion research. Annual technical report, 1980.

The year 1980 witnessed several new directions for the Laser Target Experiments Program at KMSF. Among the highlights were the conclusion of wavelength scaling experiments at 0.53 μm and 1.05 μm, and the initiation of long-gradient-length interaction studies using the gas jet target. The latter experiments required the construction and outfitting of a new laboratory for target irradiation experiments which do not require spherically symmetric illumination. A number of brief experiments answered

questions about scattered light spectra and neutron-yield scaling, while others raised new questions about second-harmonic generation and Z-dependent interactions. Integration of the KMSF program under the lead laboratory was exemplified by the participation of scientists from Livermore and NRL in the planning and execution of several experiments.

29669 (DOE/DP/40030—3, pp 3.1-3.39) **Laser fusion theory.** Campbell, P.M. 1980. NTIS, PC A11/MF A01.

In Inertial fusion research. Annual technical report, 1980.

Three major physics issues were addressed by our fusion theory program in 1980: the coupling of laser light to the plasma, the hydrodynamic effects of two-temperature, nonMaxwellian electron distributions, and the transport of energy both by electrons and by radiation. These issues were considered to be critical to our understanding of the results of experiments, both at KMSF and at other laboratories.

29670 (DOE/DP/40030—3, pp 4.1-4.38) **Laser and optics.** Moncur, N.K. 1980. NTIS, PC A11/MF A01.

In Inertial fusion research. Annual technical report, 1980.

The Chroma I laser, which was completed in 1979, was operated for target shots on a regularly scheduled basis throughout 1980 with no major configuration changes. A total of 645 full-system target shots was conducted, 441 at 1.05 μm and 204 at 0.53 μm. The frequency doubling was accomplished with 14-cm type II potassium dihydrogen phosphate (KDP) crystals placed at the output of the laser, which routinely converted over 60 percent of the 1.05 μm beam to 0.53 μm. The all-reflective triple-bounce illumination system (TBIS), which had been successfully fabricated and coated with a highly reflective dual-frequency (0.53 μm and 1.05 μm) high-power dielectric coating, was assembled and tested with a diagnostic alignment beam. Spectral diversification continued to be emphasized, with investigation of methods to modify the laser bandwidth and spectral content.

29671 **(DOE/EP—0014) Magnetic fusion: Environmental Readiness Document.** (Aerospace Corp., Germantown, MD (USA)). Mar 1981. Contract AT03-76EV74010. 65p. NTIS, PC A04/MF A01. Order Number DE81024144.

Environmental Readiness Documents are prepared periodically to review and evaluate the environmental status of an energy technology during the several phases of development of that technology. Through these documents, the Office of Environment within the Department of Energy provides an independent and objective assessment of the environmental risks and potential impacts associated with the progression of the technology to the next stage of development and with future extensive use of the technology. This Environmental Readiness Document was prepared to assist the Department of Energy in evaluating the readiness of magnetic fusion technology with respect to environmental issues. An effort has been made to identify potential environmental problems that may be encountered based upon current knowledge, proposed and possible new environmental regulations, and the uncertainties inherent in planned environmental research.

29672 **(DOE/ET/51013—1) Feasibility of a superconducting FED with 50 cm of magnet shielding.** Schultz, J.H.; Montgomery, D.B. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). 1981. Contract AC02-78ET51013. 24p. (PFC/RR—80-19). NTIS, PC A02/MF A01. Order Number DE81027691.

The feasibility of the suggestion that the cost of a Fusion Energy Device (FED) could be substantially reduced by operating with a reduced duty factor and only 50 cm of magnet shielding is evaluated here. This report examines the effect of light shielding on insulation life, matrix- and superconductor properties, refrigerator cost and steady-state heat removal. With very careful design, it appears feasible to build a device with only 50 cm of shielding.

29673 **(DOE/ET/51013—2) Sizing of the thermal and electrical systems for an FED bundle divertor design with MgO insulation.** Schultz, J.H. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center; Oak Ridge National Lab., TN (USA)). 1981. Contract AC02-78ET51013. 28p. NTIS, PC A03/MF A01. Order Number DE81027692.

The high-order dependence of toroidal ripple from a bundle divertor on the magnet shield thickness increases the desirability of a magnet technology with minimal shielding requirements. A jacketed conductor with MgO powder insulation has been used successfully in highly irradiated environments. Its properties and limitations are described. A thermal and electrical sizing code has been developed for magnet design with this technology. Two design examples for ETF and FED missions show reduced recirculating power from previously reported designs.

29674 **(DOE/ET/51013—3) High-frequency gyrotrons and their application to tokamak plasma heating.** Kreischer, K.E. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Jan 1981. Contract AC02-78ET51013. 204p. (PFC/RR—81-1). NTIS, PC A10/MF A01. Order Number DE81028268.

A comprehensive analysis of high frequency (100 to 200 GHz) and high power (> 100 kW) gyrotrons has been conducted. It is shown that high frequencies will be required in order for electron cyclotron radiation to propagate to the center of a compact tokamak power reactor. High power levels will be needed in order to ignite the plasma with a reasonable number of gyrotron units. In the first part of this research, a set of analytic expressions, valid for all TE cavity modes and all harmonics, is derived for the starting current and frequency detuning using the Vlasov-Maxwell equations in the weakly relativistic limit. The use of an optical cavity is also investigated.

29675 **(DOE/ET/51013—21) Conceptual design of a Bitter-magnet toroidal-field system for the ZEPHYR Ignition Test Reactor.** Williams, J.E.C.; Becker, H.D.; Bobrov, E.S.; Bromberg, L.; Cohn, D.R.; Davin, J.M.; Erez, E. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). May 1981. Contract AC02-78ET51013. 258p. (PFC/RR—81-24). NTIS, PC A13/MF A01. Order Number DE81027280.

The following problems are described and discussed: (1) parametric studies - these studies examine among other things the interdependence of throat stresses, plasma parameters (margins of ignition) and stored energy. The latter is a measure of cost and is minimized in the present design; (2) magnet configuration - the shape of the plates are considered in detail including standard turns, turns located at beam ports, diagnostic and closure flanges; (3) ripple computation - this section describes the codes by which ripple is computed; (4) field diffusion and nuclear heating - the effect of magnetic field diffusion on heating is considered along with neutron heating. Current, field and temperature profiles are computed; (5) finite element analysis - the two and three dimensional finite element codes are described and the results discussed in detail; (6) structures engineering - this considers the calculation of critical stresses due to toroidal and overturning forces and discusses the method of constraint of these forces. The Materials Testing Program is also discussed; (7) fabrication - the methods available for the manufacture of the constituent parts of the Bitter plates, the method of assembly and remote maintenance are summarized.

29676 **(DP-MS—80-130) Exposure and temperature dependence of elongated blister formation in complex radiation environments.** McDonell, W.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1981. Contract AC09-76SR00001. 5p. (CONF-810831—1). NTIS, PC A02/MF A01. Order Number DE81025499.

From Fusion reactor materials meeting; Seattle, WA, USA (9 Aug 1981).

Blistering of platinum alloy surfaces by ^{252}Cf alpha particle and fission fragment radiations occurred at relatively low concentrations of implanted helium during exposures at room temperature as well as at 1000°C. Distinctive configurations of the blisters resulting from transport of atoms displaced by the fission fragments persisted during the high temperature exposures. Post-exposure heating of specimens exposed at room-temperature produced no additional blistering until temperatures of 1300°C were reached. Post-exposure heating of 1000°C blistered specimens produced only thermal etching effects. The low helium concentrations required for blistering and the distinctive blister configurations produced by ^{252}Cf exposures suggest a unique mode of surface distortion result-

ing from the large number and highly localized distributions of atom displacements generated by ^{252}Cf fission fragments. Such conditions may not be duplicated in the He-ion and fast neutron radiation environments of fusion reactors.

29677 (GA-A—15097) Neutral-beam injection for the Doublet III device. Kamperschroer, J.H.; Bhadra, D.K. (General Atomic Co., San Diego, CA (USA)). Aug 1978. Contract AT03-76ET51011. 44p. NTIS, PC A03/MF A01. Order Number DE81024357.

Neutral beam injection into Doublet III has been considered with regard to the loss of injected particles, instability excitation, and edge effects. Beam loss is expected to be ~ 5% due to non-thermalized drift orbit losses, including toroidal gyro-radius effects and plasma transparency, for 80 keV injection into plasmas with 10^{14} cm^{-3} ≦ n(o) ≦ 3 x 10^{14} cm^{-3}. Oblique beam injection may lead to the excitation of plasma waves at the lower hybrid frequency. Excitation of such instabilities may cause anomalous diffusion and affect plasma confinement. A power balance was also carried out for the edge of the plasma to determine heating at this location due to the low energy component of the beam. An edge heating rate of several keV/sec is predicted for the injection of 7.2 MW of neutrals into a plasma with n(o) = 2 x 10^{14} cm^{-3}.

29678 (GA-A—16134) Guide to the data-acquisition software of the Doublet III computer system. McHarg, B.B. (General Atomic Co., San Diego, CA (USA)). Dec 1980. Contract AT03-76ET51011. 73p. NTIS, PC A04/MF A01. Order Number DE81026616.

The Doublet III tokamak fusion experiment acquires, processes and archives over two megabytes of experimental data from each tokamak shot, which occurs every five to seven minutes. The computer codes that accomplish this acquisition begin execution immediately on reboot of the computer system and continue throughout the preacquisition stage before a tokamak shot, the actual acquisiton stage when the shot is fired, and the post-acquisition or analysis stage. This document is intended to serve as a guide to the software of the Doublet III data acquisition system and discusses the interaction of the computer codes with each other as well as with data base files, data files, and global tables. Detailed descriptions of these files and tables are given along with methods of modification.

29679 (GA-A—16307) Discharge initiation with an in-situ hydrogen pellet in Doublet III. Malcus, F.B.; Baker, D.R.; Blau, F.P.; Chase, R.P.; Fairbanks, E.S.; Jahns, G.L.; Luxon, J.L.; Snider, R.T. (General Atomic Co., San Diego, CA (USA)). Apr 1981. Contract AT03-76ET51011. 7p. (CONF-810906—3). NTIS, PC A02/MF A01.

From 10. European conference on controlled fusion and plasma physics; Moscow, USSR (14 Sep 1981).

The results of the in-situ pellet experiments in Doublet III are summarized, with particular attention to the recent measurements of the electron temperature and density during the early phase of the discharge when large vertical elongations are achieved.

29680 (HEDL—6912) Nuclear data for damage studies and FMIT (WH025/EDK). Johnson, D.L.; Mann, F.M. (Hanford Engineering Development Lab., Richland, WA (USA)). Jan 1981. Contract AC14-76FF02170. 8p. NTIS, PC A02/MF A01. Order Number DE81026491.

Additional evaluation of deuteron induced activation of gold and aluminum was done to provide dose estimates. An evaluation was made of the neutron environment at large angles to the 35 MeV deuteron beam in the FMIT test cell for comparison with positions at small angles to a 20 MeV beam. Predictions of the neutron source characteristics for deuterons incident upon gold were made to aid in dose estimates near the accelerator.

29681 (HEDL-SA—2226) Materials problems in breeder and fusion energy systems. Yoshikawa, H.H. (Hanford Engineering Development Lab., Richland, WA (USA)). Aug 1980. Contract AC14-76FF02170. 9p. (CONF-810148—1). NTIS, PC A02/MF A01. Order Number DE81025841.

From 1981 Golden Gate metals and welding conference; San Francisco, CA, USA (21 Jan 1981).

Adequate materials are essential for the success of both the Breeder and Fusion Programs. In both systems the performance of the material surrounding the source of heat, cladding for the breeder, the first-wall for fusion, can determine whether the system will be practical. A major thrust in breeder programs internationally is the development of cladding and duct materials that will achieve the extended lifetimes needed for power plants. The US program, started some six years ago, is producing encouraging results. The recently completed Fast Flux Test Reactor will provide lifetime testing of material samples and of fuel elements. In the technologically unproven fusion area the clear need for adequate materials is recognized. The higher energy neutron environments, extended lifetime requirements, and different materials requirements make the search for fusion materials a major challenge. The Fusion Materials Irradiation Test Facility, now in early construction, will provide accelerated test data on radiation effects.

29682 (KMSF-U—1087) Gas-jet laser-plasma interaction experiments. Mayer, F.J.; Buoniconto, M.A.; Busch, G.E. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1981. Contract AC08-78DP40030. 3p. (CONF-810613—8). NTIS, PC A02/MF A01. Order Number DE81027169.

From Conference on lasers and electro-optics; Washington, DC, USA (10 Jun 1981).

Preliminary results of laser-plasma interaction studies at 1.06 and 0.53 μm with gas-jet targets are presented. Stimulated Brillouin backscatter is strong in the 100 μm scale-length plasmas, but sidescatter is weak. Temperature, transport, and absorption measurements are discussed.

29683 (LA—8557) Models and analyses for inertial-confinement fusion-reactor studies. Bohachevsky, I.O. (Los Alamos National Lab., NM (USA)). May 1981. Contract W-7405-ENG-36. 65p. NTIS, PC A04/MF A01. Order Number DE81026804.

This report describes models and analyses devised at Los Alamos National Laboratory to determine the technical characteristics of different inertial confinement fusion (ICF) reactor elements required for component integration into a functional unit. We emphasize the generic properties of the different elements rather than specific designs. The topics discussed are general ICF reactor design considerations; reactor cavity phenomena, including the restoration of interpulse ambient conditions; first-wall temperature increases and material losses; reactor neutronics and hydrodynamic blanket response to neutron energy deposition; and analyses of loads and stresses in the reactor vessel walls, including remarks about the generation and propagation of very short wavelength stress waves. A discussion of analytic approaches useful in integrations and optimizations of ICF reactor systems concludes the report.

29684 (LA-UR—81-1671) Advanced development of electrical-energy-storage components for high-reliability applications. Bickford, K.J.; Mauldin, G.H.; Sargeant, W.J. (Los Alamos National Lab., NM (USA); Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract W-7405-ENG-36. 5p. (CONF-810659—15). NTIS, PC A02/MF A01. Order Number DE81025384.

From 3. IEEE international pulsed power conference; Albuquerque, NM, USA (1 Jun 1981).

This program was undertaken in order to study the following: (1) design and fabrication of prototype test capacitors; (2) dc partial discharge analysis; (3) repetitive charge-discharge life testing; (4) theoretical and experimental analysis; and (5) computer modeling. A brief overview of each of these program elements is presented. (MOW)

29685 (LA-UR—81-1750) Uncertainties associated with inertial-fusion ignition. McCall, G.H. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 10p. (CONF-810429—34). NTIS, PC A02/MF A01. Order Number DE81025408.

From Conference on optics; Santa Fe, NM, USA (6 Apr 1981).

An estimate is made of a worst case driving energy which is derived from analytic and computer calculations. It will be shown

that the uncertainty can be reduced by a factor of 10 to 100 if certain physical effects are understood. That is not to say that the energy requirement can necessarily be reduced below that of the worst case, but it is possible to reduce the uncertainty associated with ignition energy. With laser costs in the $0.5 to 1 billion per MJ range, it can be seen that such an exercise is worthwhile.

29686 **(LA-UR—81-1849) Scaling laws for simple heavy ion targets.** Gula, W.P.; Magelssen, G.R. (Argonne National Lab., IL (USA)). 1981. Contract W-7405-ENG-36. 9p. (CONF-810620—11). NTIS, PC A02/MF A01. Order Number DE81025346.

From 4. international topical conference on high-power electron and ion-beam research and technology; Palaiseau, France (29 Jun 1981).

We have examined the behavior of single shell DT gas filled spherical targets irradiated by a constant power heavy ion beam pulse. For targets in which the ion range is less than the shell thickness, our computational results suggest that the target can be divided into three regions: (1) the absorber (100 to 400 eV for the energies we have considered), (2) the cold pusher (a few eV), and (3) the DT gas fuel. We have examined the pusher collapse time, velocity, and maximum kinetic energy variations as functions of the various target parameters and ion beam energy. The results are expressed in analytic terms and verified by computer simulation.

29687 **(LA-UR—81-1873) Electron-temperature requirements for neutralized inertial-confinement-fusion light-ion beams.** Lemons, D.S. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 12p. (CONF-810620—9). NTIS, PC A02/MF A01. Order Number DE81025352.

From 4. international topical conference on high-power electron and ion-beam research and technology; Palaiseau, France (29 Jun 1981).

Because of their large self-space-charge fields, light ion beam drivers of energy and power sufficient to achieve inertial confinement fusion (ICF) cannot be focused on a small fuel pellet unless neutralized. Even if initially neutralized with comoving electrons, these beams will not stay neutralized and focus during propagation through a vacuum chamber unless the initial thermal energy of the neutralizing electrons is sufficiently small. In this paper we discuss the effects which contribute to the effective initial temperature of the neutralizing electrons, including compressional shock heating. We also employ a simple heuristic model to construct envelope equations which govern axial as well as radial beam compression and use them to predict the largest initial electron temperature consistent with the required beam compression. This temperature for typical light ion beam systems is about ten eV - a temperature which may be possible to achieve.

29688 **(LA-UR—81-1906) Hydrogen storage-bed design for tritium systems test assembly.** Cullingford, H.S.; Wheeler, M.G.; McMullen, J.W. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 18p. (CONF-810497—1). NTIS, PC A02/MF A01. Order Number DE81025336.

From International symposium on metalhydrogen systems; Miami Beach, FL, USA (13 Apr 1981).

The Los Alamos National Laboratory has completed the design of a hydrogen storage bed for the Tritium Systems Test Assembly (TSTA). Our objective is to store hydrogen isotopes as uranium hydrides and recover them by dehydriding. The specific use of the storage bed is to store DT gas as $U(D,T)_3$ when it is required for the TSTA. The hydrogen storage bed consists of a primary container in which uranium powder is stored and a secondary container for a second level of safety in gas confinement. The primary container, inlet and outlet gas lines, cartridge heaters, and instrumentation are assembled in the secondary container. The design of the hydrogen storage bed is presented, along with the modeling and analysis of the bed behavior during hydriding-dehydriding cycles.

29689 **(LA-UR—81-1943) Redundant control systems for TSTA.** Damran, J.J. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 10p. (CONF-810623—10). NTIS, PC A02/MF A01. Order Number DE81025369.

From 24. midwest symposium on circuits and systems; Albuquerque, NM, USA (29 Jun 1981).

The Tritium Systems Test Assembly (TSTA) is a Los Alamos National Laboratory facility being constructed for the purpose of developing, demonstrating, and interfacing technologies required in the deuterium-tritium fuel cycle of future fusion reactor systems. The control of the facility is performed by the Master Data Acquisition and Control System (MDAC). The MDAC employs eight computers in a multi-redundant configuration ensuring both the safe and reliable operation of the facility and a high degree of system availability. To accomplish this task, MDAC is separated into two isolated branches, one designated as the process branch and the other as the safety branch.

29690 **(LBL—12383) Conceptual design for the ZEPHYR neutral-beam injection system.** Cooper, W.S.; Elischer, V.P.; Goldberg, D.A.; Hopkins, D.B.; Jacobson, V.L.; Lou, K.H.; Tanabe, J.T. (Lawrence Berkeley Lab., CA (USA)). Mar 1981. Contract W-7405-ENG-48. 172p. NTIS, PC A08/MF A01. Order Number DE81028089.

In June 1980, the Lawrence Berkeley Laboratory began a conceptual design study for a neutral beam injection system for the ZEPHYR ignition tokamak proposed by the Max-Planck-Institut fur Plasmaphysik in Garching, Germany. The ZEPHYR project was cancelled, and the LBL design effort concluded prematurely in January 1981. This report describes the conceptual design as it existed at that time, and gives brief consideration to a schedule, but does not deal with costs.

29691 **(LBL—12855) Proton induction linacs as high-intensity neutron sources.** Keefe, D.; Hoyer, E. (Lawrence Berkeley Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 12p. (CONF-8106120—4). NTIS, PC A02/MF A01. Order Number DE81025825.

From 5. meeting of the international collaboration on advanced neutron sources; Julich, F.R. Germany (22 Jun 1981).

Proton induction linacs are explored as high intensity neutron sources. The induction linac - concept, properties, experience with electrons, and possibilities - and its limitations for accelerating ions are reviewed. A number of proton induction linac designs are examined with the LIACEP program and general conclusions are given. Results suggest that a proton induction accelerator of the lowest voltage, consistent with good neutron flux, is preferred and could well be cost competitive with the usual rf linac/storage ring designs.

29692 **(NBSIR—81-1645) Materials studies for magnetic fusion energy applications at low temperatures. IV.** Reed, R.P.; Simon, N.J. (eds.). (National Bureau of Standards, Boulder, CO (USA). Fracture and Deformation Div.). Apr 1981. 634p. NTIS, PC A99/MF A01. Order Number DE81025676.

Separate abstracts were prepared for 27 of the included sections. (MOW)

29693 **(ORNL—5777) Calculation procedures for the analysis of integral experiments for fusion-reactor design.** Santoro, R.T.; Barnes, J.M.; Alsmiller, R.G. Jr.; Oblow, E.M. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 48p. NTIS, PC A03/MF A01. Order Number DE81027626.

The calculational models, nuclear data, and radiation transport codes that are used in the analysis of integral measurements of the transport of ~ 14 MeV neutrons through laminated slabs of materials typical of those found in fusion reactor shields are described. The two-dimensional discrete ordinates calculations to optimize the experimental configuration for reducing the neutron and gamma ray background levels and for obtaining an equivalent, reduced geometry of the calculational model to reduce computer core storage and running times are also presented. The equations and data to determine the energy-angle relations to neutrons pro-

duced in the reactions of 250 keV deuterons in a titanium-tritide target are given. The procedures used to collapse the 17ln-36γ VITAMIN C cross section data library to a 53n-21γ broad group library are described. Finally, a description of the computer code network used to obtain neutron and gamma ray energy spectra for comparison with measured data is included.

29694 **(ORNL/MIT—323) High-efficiency targets for neutral beams.** Sincali, A.J.; Chuang, C.C. (Oak Ridge National Lab., TN (USA); Massachusetts Inst. of Tech., Oak Ridge, TN (USA). School of Chemical Engineering Practice). Jul 1981. Contract W-7405-ENG-26. 86p. NTIS, PC A05/MF A01. Order Number DE81027108.

A one-dimensional heat transfer model was developed to predict the temperature profiles and thermal stresses within two proposed neutral-beam target designs: swirl tubes and electroformed, oxygen-free, high-conductivity (OFHC) copper plates. The optimal design and operation of each proposal were evaluated with two separate water supplies. The target designs were optimized to obtain maximum critical heat flux while maintaining acceptable target surface temperatures, minimum thermal stresses, and practical water-supply requirements. A target design using 0.635-cm-ID swirl tubes dissipated incident power densities of 7 kW/cm^2 with water flow rates of 3.78 x 10^3 kg/min (1000 gpm), inlet pressures of 3.76 MPa (545 psi) and exit pressures of 0.34 MPa (50 psi). This power dissipation is three times that of existing targets. Thermal stress analysis revealed that annealed copper would bend at incident heat fluxes greater than 1.5 kW/cm^2.

29695 **(ORNL/Sub—79/21453/6) 60 GHz gyrotron development program. Quarterly report No. 6, October-December 1980.** Shively, J.F.; Cheng, M.K.; Evans, S.E.; Grant, T.J.; Stone, D.S. (Oak Ridge National Lab., TN (USA); Varian Associates, Palo Alto, CA (USA). Palo Alto Microwave Tube Div.). 1981. Contract W-7405-ENG-26. 51p. NTIS, PC A04/MF A01. Order Number DE81026872.

The objective of this program is to develop a microwave oscillator capable of producing 200 kW of CW output power at 60 GHz. The use of cyclotron resonance interaction is being pursued. The design, procurement and construction phases of this program are discussed. Progress on gyrotron behavior studies being performed at 28 GHz are also discussed.

29696 **(ORNL/TM—7729) Optimization of EBT reactor magnetics.** Owen, L.W.; Uckan, N.A. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 67p. NTIS, PC A04/MF A01. Order Number DE81027825.

Optimization of the vacuum magnetic field of an ELMO Bumpy Torus (EBT) reactor is investigated. Several methods of improving reactor volume utilization and single particle confinement are analyzed. These include the use of (1) a large number of sectors and/or a large mirror ratio, (2) high field Nb_3Sn or Nb_3Sn/NbTi hybrid mirror coils, (3) split-wedge mirror coils, (4) axis-encircling aspect ratio enhancement (ARE) coils, and (5) recently developed field symmetrizing (SYM) coils.

29697 **(ORNL/TM—7774) Effects of toroidal field ripple on injected deuterons in the FED device.** Fowler, R.H.; Rome, J.A. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 22p. NTIS, PC A02/MF A01. Order Number DE81027069.

A Monte Carlo beam deposition and thermalization code is used to assess the effects of toroidal field (TF) ripple on injected fast deuterons in the Fusion Engineering Device (FED). The code uses realistic geometry for the beam, plasma equilibrium, TF ripple, and vacuum chamber. For injection at an angle of 35° (co) from perpendicular, no particles were ripple trapped and less than 1% of the injected power went to the wall and the limiter. However, due to the large amounts of computer time required by these programs, only 100 particles were followed in the rippled case and the results must be regarded as preliminary.

29698 **(ORNL/TM—7803) Physics considerations for the FED limiter.** Howe, H.C. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 36p. NTIS, PC A03/MF A01. Order Number DE81027596.

The physics of the scrapeoff plasma and its interaction with a pumping limiter is reviewed. The governing equations for heat and particle transport in the scrapeoff are solved analytically with several simplifying assumptions. The assumed scrapeoff model is widely used and is presented here for completeness. From the solution, a shape for the limiter is derived which has a uniform heat loading on the front surface. The assumed crossfield transport coefficient is varied to examine the sensitivity of the heat loading to variations in plasma scrapeoff thickness. The heat flux to the limiter leading edge is an extremely sensitive function of variations in scrapeoff thickness, and we argue that uncertainties in the plasma crossfield transport preclude derivation of a believable limiter shape. We also discuss the problems involved with an edgeless, perforated limiter and with a global limiter. Finally, a solution is proposed using a flat-plate limiter with the heat flux to the leading edge controlled by major radius motion of the plasma.

29699 **(ORNL/TM—7811) Mechanical reliability of ceramics for microwave window applications.** Becher, P.F.; Ferber, M.K.; Tennery, V.J. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 37p. NTIS, PC A03/MF A01. Order Number DE81027627.

Materials presently being evaluated for use in the output window of gyrotron tubes include structural ceramics made of alumina (α-Al_2O_3) and beryllia (BeO). Other candidate ceramics are also being considered. Several properties of the window materials will determine their ability to operate successfully under the anticipated conditions. The strength of alumina, beryllia, and other ceramic materials is described in terms of the statistical nature of their fracture, including the use of Weibull statistics to determine the probability of fracture for a material as a function of the applied stress.

29700 **Sputtering of TiB/sub 2/ coatings under D/sup +/ and /sup 4/He/sup +/ ion bombardment.** Kaminsky, M.; Lam, S.K.; Moy, K. (Argonne Natl Lab, IL). *Thin Solid Films ;* **73**: No. 1, 91-97(3 Nov 1980).

The release of sputtered material from chemically vapor-deposited TiB/sub 2/ coatings on Poco graphite substrates was studied for mass-analyzed D/sup +/ and /sup 4/He/sup +/ ion irradiations with energies ranging from 3 to 15 keV at normal incidence. The chemical composition of the sputter deposits was analyzed by Auger electron spectroscopy. The relevance of data for the fusion program is discussed. 14 refs.

29701 **(SAND—80-2870C) Shock effects in particle-beam fusion targets.** Sweeney, M.A.; Perry, F.C.; Asay, J.R.; Widner, M.M. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 5p. (CONF-810684—41). NTIS, PC A02/MF A01. Order Number DE81027806.

From APS conference on shock waves in condensed matter; Menlo Park, CA, USA (23 Jun 1981).

At Sandia National Laboratories we are assessing the response of fusion target materials to shock loading with the particle beam accelerators HYDRA and PROTO I and the gas gun facility. Nonlinear shock-accelerated unstable growth of fabrication irregularities has been demonstrated, and jetting is found to occur in imploding targets because of asymmetric beam deposition. Cylindrical ion targets display an instability due either to beam or target nonuniformity. However, the data suggest targets with aspect ratios of 30 may implode stably. The first time- and space-resolved measurements of shock-induced vaporization have been made. A homogeneous mixed phase EOS model cannot adequately explain the results because of the kinetic effects of vapor formation and expansion.

29702 **(SAND—81-0270C) Coated-limiter testing in tokamaks.** Whitley, J.B.; Mullendore, A.W.; Mattox, D.M.; Trester, P.W.; Emerson, L.C. (Sandia National Labs., Albuquerque, NM (USA); General Atomic Co., San Diego, CA (USA); Oak Ridge National Lab., TN (USA)). 1981. Contract AC04-76DP00789. 7p. (CONF-810831—5). NTIS, PC A02/MF A01. Order Number DE81027665.

From Fusion reactor materials meeting; Seattle, WA, USA (9 Aug 1981).

Over the past year, extensive operating experience has been gained with coated graphite limiters in the ISX-B and Doublet III tokamaks. A total of approximately 20,000 tokamak discharges have been performed with TiC coated limiters, and the plasma performance and capability with these limiters has been improved over that obtained with metallic limiters. While none of the limiters have failed while in service, the TiC coating and in some cases the graphite substrate have experienced damage. This damage consists of grooves formed in the coating and an area of coating melt and graphite cracking. The groove damage is believed to have been caused by disruptions and the melt region by the high heat loads during neutral beam heated discharges.

29703 **(SAND—81-0295C) Trap activation model for hydrogen retention and isotope exchange in some refractory materials.** Brice, D.K.; Doyle, B.L. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 5p. (CONF-810831—2). NTIS, PC A02/MF A01. Order Number DE81025995.

From Fusion reactor materials meeting; Seattle, WA, USA (9 Aug 1981).

Our recently developed Local Mixing Model (LMM) has been successful in describing and predicting the properties of hydrogen retention and isotope exchange for a variety of refractory materials. For some materials, however, the detailed predictions of the LMM are not observed. A Trap Activation Model (TAM) is proposed here to account for the observed departures from the LMM. Comparison of experimental room temperature saturation depth profiles for $H^+ \rightarrow Si$ with the predictions of TAM suggests that the hydrogen traps are multiple-vacancy complexes in this system. The observed profiles result from a beam-induced competition between trap creation/annihilation and H-trapping/detrapping.

29704 **(SAND—81-0617C) High energy density capacitor testing for the AFWL SHIVA.** Smith, D.L.; Reinovsky, R.E. (Sandia National Labs., Albuquerque, NM (USA); Air Force Weapons Lab., Kirtland AFB, NM (USA)). 1981. Contract AC04-76DP00789. 4p. (CONF-810659—18). NTIS, PC A02/MF A01. Order Number DE81023688.

From 3. IEEE international pulsed power conference; Albuquerque, NM, USA (1 Jun 1981).

The SHIVA II Prime upgrade consists of replacing the existing 3.3 kJ, 1.85 μF capacitors with plug-in higher energy density capacitors. Based on capacitor development work by manufacturers it appears that a nominal 6 μF, 60 kV capacitor in an 11" x 14" can is near the limits of current technology. Using the 6 μF, 10.8 kJ capacitor results in a factor of 3 increase in stored energy at no increase in operational voltage. The equivalent system capacitance will then be 864 μF at 120 kV (+-60 kV) or 6.22 MJ. The best testing technique is one which duplicates, as nearly as reasonable, the actual parameters the capacitors would see in the full-scale system. Lifetime testing and analysis of small samples of high energy density (HED) discharge capacitors at the AFWL were conducted to find a component suitable for upgrading the SHIVA capacitor bank to a 6 MJ facility. Evaluation was performed with discharge conditions of approximately 250 kA per capacitor at 60 to 70% reversal and < 2 μs quarter period. Dielectric systems including Kraft paper with caster oil impregnant and Kraft paper, polypropylene with DiOctyl Phthalate (DOP) impregnant were tested.

29705 **(SAND—81-0672C) Scalability of light ion beams to reach fusion conditions.** Kuswa, G.W.; Quintenz, J.P.; Seidel, D.B. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 26p. (CONF-810620—12). NTIS, PC A03/MF A01. Order Number DE81024443.

From 4. international topical conference on high-power electron and ion-beam research and technology; Palaiseau, France (29 Jun 1981).

Two variations of an intense ion beam diode having magnetic insulation generated either by an external capacitor bank (radial ion diode) or by diode current passing through coil-like vanes, (AMPFION) are described. Advantages in energy delivery and focusability make AMPFION the best candidate for attaining ignition.

29706 **(SAND—81-0755C) Modular accelerator interconnecting and operating systems for PBFA-I.** White, R.A. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 4p. (CONF-810659—24). NTIS, PC A02/MF A01. Order Number DE81025397.

From 3. IEEE international pulsed power conference; Albuquerque, NM, USA (1 Jun 1981).

This paper discusses some of the many systems used to operate PBFA-I. High voltage electrical systems for charging and firing the energy storage section and for simultaneously triggering 36 separate, 2.5 megavolt spark gaps in the pulse forming section are described. The first full power shot of PBFA-I was made on June 28, 1980. Developmental operation of the accelerator has continued for about a year. Description and early test results have been reported elsewhere in this and previous conferences.

29707 **(SAND—81-1553C) Considerations for the design, implementation, and effective operation of Sandia's superpower generators.** Goldstein, S.A.; Barr, G.W.; VanDevender, J.P.; Martin, T.H. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 4p. (CONF-810659—25). NTIS, PC A02/MF A01. Order Number DE81025404.

From 3. IEEE international pulsed power conference; Albuquerque, NM, USA (1 Jun 1981).

After firing its first full power, 36-module shot on June 28, 1980, on schedule and on budget, the PBFA-I Accelerator progressed from an output parameter characterization phase through a stable operating point optimization phase and into an operational phase for conducting advanced power flow studies and ion beam driven inertial confinement fusion experiments. This paper describes the development of the PBFA Facility from the viewpoints of facility and accelerator design criteria, implementation of these designs, and effective operation.

29708 **(UCID—19150) Effect of non-adiabaticity of alpha particles in the axisymmetric cusp TMR.** Carlson, G.A.; Barr, W.L. (Lawrence Livermore National Lab., CA (USA)). 20 Jul 1981. Contract W-7405-ENG-48. 20p. NTIS, PC A02/MF A01. Order Number DE81025460.

One of the end plug configurations we have investigated for use in a tandem mirror reactor is the axisymmetric cusp. We show that because of non-adiabaticity, the containment of 3.5 MeV alpha particles in this configuration is insufficient for the attainment of acceptable plasma performance.

29709 **(UCRL—15367) Research on the HYLIFE liquid-first-wall concept for future laser-fusion reactors. Final report No. 6.** Hoffman, M.A. (California Univ., Davis (USA). Dept. of Mechanical Engineering). Dec 1980. Contract W-7405-ENG-48. 36p. NTIS, PC A03/MF A01. Order Number DE81026594.

Experiments were performed on planar sheet jets of water flowing vertically downward. The nozzles were vibrated transversely to excite the sinuous mode of instability, and the sheet jets were photographed from the edge view to obtain data on the wave growth parameters. The data are compared to a second-order nonlinear theory. Qualitative agreement is obtained with regard to the stabilizing nature of the second-order terms, and reasonably quantitative agreement is obtained on the fall distance for the maximum wave amplitude.

29710 **(UCRL—53123) Treatment of θ-directed magnetic fields in LASNEX.** Nielsen, P.D.; Zimmerman, G.B. (Lawrence Livermore National Lab., CA (USA)). 5 Feb 1981. Contract W-7405-ENG-48. 51p. NTIS, PC A04/MF A01. Order Number DE81026329.

The computational routines used to include the effects of magnetic fields in LASNEX are presented and discussed. Subroutines for the solution of the magnetic induction equation and the magnetic contributions to the electron temperature equation are analyzed in detail. Flow charts, summary equations with multipliers and keys to edited quantities are included.

29711 **(UCRL—83550) Human interface to a major fusion experiment, a graphics solution.** Speckert, G.C.; McGoldrick, P.R.; Nowell, D.M.; Wade, J.W. (California Univ., Berkeley (USA); Lawrence Livermore National Lab., CA (USA)). 30 Nov 1979. Contract W-7405-ENG-48. 30p. (CONF-800720—4). NTIS, PC A03/MF A01. Order Number DE81026592.

From Conference of the Association for Computing Machinery, special interest group for graphics; Seattle, WA, USA (14 Jul 1980).

This paper reports a case history of the design and implementation of the man/machine interface for a large control system, the Mirror Fusion Test Facility (MFTF). Work on the man/machine interface commenced in 1977 with a one million dollar budget (hardware plus 10 man years of effort). The MFTF is fairly complex, consisting of over 3000 devices to control and 7000 sensors to monitor. The control system comprises 9 minicomputers and 65 microcomputers.

29712 **(UCRL—85452) Effects of fusion neutrons on thermocouples.** Logan, C.M.; Heikkinen, D.E.; Schumacher, B.J.; House, P.A. (California Univ., Berkeley (USA); Lawrence Livermore National Lab., CA (USA)). 1981. Contract W-7405-ENG-48. 6p. (CONF-810831—4). NTIS, PC A02/MF A01. Order Number DE81026004.

From Fusion reactor materials meeting; Seattle, WA, USA (9 Aug 1981).

Thermocouples are being utilized in present-generation fusion experiments, both materials and confinement, and will see increased application as these experiments become more complex. Little is known about the response of thermocouples to radiation exposure of any kind. Nothing is known about 14-MeV neutron effects. We have conducted a room-temperature irradiation at RTNS-II to survey seven common thermocouple alloys for fusion-neutron-induced changes in thermoelectric output. Effects are observable in all materials. In some materials the observed effect is modified or removed by annealing. Other materials exhibit effects which are stable to or enhanced by elevated temperature exposure.

29713 **(UCRL—85506) Microstructures for high-energy x-ray and particle-imaging applications.** Ceglio, N.M.; Stone, G.F.; Hawryluk, A.M. (Lawrence Livermore National Lab., CA (USA); Massachusetts Inst. of Tech., Cambridge (USA)). May 1981. Contract W-7405-ENG-48. 18p. (CONF-8105103—1). NTIS, PC A02/MF A01. Order Number DE81026531.

From 16. symposium on electron ion and photo beam technology; Dallas, TX, USA (26 May 1981).

Coded imaging techniques using thick, micro-Fresnel zone plates as coded apertures have been used to image x-ray emissions (2-20 keV) and 3.5 MeV Alpha particle emissions from laser driven micro-implosions. Image resolution in these experiments was 3-8 μm. Extension of this coded imaging capability to higher energy x-rays (~ 100 keV) and more penetrating charged particles (e.g. ~ 15 MeV protons) requires the fabrication of very thick (50-200 μm), high aspect ratio (10:1), gold Fresnel zone plates with narrow linewidths (5-25 μm) for use as coded aperatures. A reactive ion etch technique in oxygen has been used to produce thick zone plate patterns in polymer films. The polymer patterns serve as electroplating molds for the subsequent fabrication of the free-standing gold zone plate structures.

29714 **(UCRL—85651) Heavy ion beam degradation from stripping in near vacuum reactor chambers.** Barletta, W.A. (California Univ., Berkeley (USA); Lawrence Livermore National Lab., CA (USA)). 21 Jul 1981. Contract W-7405-ENG-48. 12p. (CONF-810620—13). NTIS, PC A02/MF A01. Order Number DE81026528.

From 4. international topical conference on high-power electron and ion-beam research and technology; Palaiseau, France (29 Jun 1981).

With the use of a particle simulation code we have investigated the ballistic transport of heavy ion beams through a gas-filled reactor for inertial confinement fusion. The background gas pressure has been taken to be 10^{-4} torr - 10^{-3} torr of Lithium vapor as is appropriate to the HYLIFE reactor concept. During transport to the pellet, Coulomb collisions of beam particles with the background gas will convert a fraction of the beam to charges states higher than the initial value. Collisons will also produce an associated swarm of knock-on electrons. As the beam approaches the pellet, anharmonic components of the space charges forces will lead to a distortion of the phase space of the beam and a consequent degradation of the focal properties of the beam. This degradation can be described in terms of an increase in the rms emittance of the beam. The degree of emittance growth depends sensitivity upon the initial spatial distribution of particles in the beam. For this study we have modified a single-disk particle simulation code, DESTIN (2), to follow two species of particles, the number of which varies in a prescribed fashion dependent upon reactor temperature as the beam converges toward the pellet.

29715 **(UCRL—85669) Software design of a general purpose data acquisition and control executive.** Labiak, W.G.; Minor, E.G. (California Univ., Berkeley (USA); Lawrence Livermore National Lab., CA (USA)). 22 May 1981. Contract W-7405-ENG-48. 5p. (CONF-810523—9). NTIS, PC A02/MF A01. Order Number DE81026573.

From Topical conference on computerized data acquisition in particle and nuclear physics; Oak Ridge, TN, USA (28 May 1981).

The software design of an executive which performs general purpose data acquisition, monitoring, and control is presented. The executive runs on a memory-based mini or micro-computer and communicates with a disk-based computer where data analysis and display are done. The executive design stresses reliability and versatility, and has yielded software which can provide control and monitoring for widely different hardware systems. Applications of this software on two major fusion energy experiments at Lawrence Livermore National Laboratory will be described.

29716 **(UCRL—85720) Nova pulse power system description and status.** Holloway, R.W.; Whitham, K.; Merritt, B.T.; Gritton, D.G.; Oicles, J.A. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 1 Jun 1981. Contract W-7405-ENG-48. 5p. (CONF-810659—16). NTIS, PC A02/MF A01. Order Number DE81025600.

From 3. IEEE international pulsed power conference; Albuquerque, NM, USA (1 Jun 1981).

The Nova laser system is designed to produce critical data in the nation's inertial confinement fusion effort. It is the world's largest peak power laser and presents various unique pulse power problems. In this paper, pulse power systems for this laser are described, the evolutionary points from prior systems are pointed out, and the current status of the hardware is given.

29717 **(UCRL—85721) Elastomer unistructure insulators.** Bradley, L.P.; Orham, E.L.; Anderson, R.L. (Lawrence Livermore National Lab., CA (USA); American Controls, Inc., San Diego, CA). 1 Jun 1981. Contract W-7405-ENG-48. 4p. (CONF-810659—26). NTIS, PC A02/MF A01. Order Number DE81024366.

From 3. IEEE international pulsed power conference; Albuquerque, NM, USA (1 Jun 1981).

A single elastomer high voltage dielectric provides low inductance interconnection of capacitors, railgaps, and vacuum load. It complies against conductors to prevent tracking. Operation below a threshold breakdown field provides long lifetime.

29718 **(UCRL—85760) Testing and optimizing active rotary flux compressors.** Carder, B.M.; Eimerl, D.; Goodwin, E.J.; Trenholme, J.; Foley, R.J.; Bird, W.L. (Sandia National Labs., Livermore, CA (USA); Texas Univ., Austin (USA). Center for Electromechanics). 1 Jun 1981. Contract W-7405-ENG-48. 5p. (CONF-810659—20). NTIS, PC A02/MF A01. Order Number DE81024376.

From 3. IEEE international pulsed power conference; Albuquerque, NM, USA (1 Jun 1981).

The test program for an Active Rotary Flux Compressor (ARFC) has demonstrated conclusively that large compression factors can be obtained with a laminated-iron, wave-wound, rotary flux compressor. Peak-current to startup-current ratios of 17 have been produced with a rotor tip speed of 60 meters per second. Submillisecond pulse widths were also measured: the minimum, 590 μsec (FWHM), was obtained at 5607 rpm with an 8-inch diameter,

4-pole rotor. The machine was operated without a high current output switch, proving the feasibility of a novel commutation scheme described. A computational code has been developed that will calculate the output waveshape of the model ARFC with reasonable accuracy. The code is being refined to better account for saturation in the iron laminations. A second optimization code selects the best design for a given application. This code shows favorable cost effectiveness of large ARFC's over the conventional capacitors to drive flashlamps for large lasers.

29719 **(UCRL—85867) One-dimensional magnetohydrodynamic calculations of a hydrogen-gas puff.** Maxon, S.; Nielsen, P.D. (Lawrence Livermore National Lab., CA (USA)). 20 Apr 1981. Contract W-7405-ENG-48. 5p. (CONF-810906—1). NTIS, PC A02/MF A01.

From 10. European conference on controlled fusion and plasma physics; Moscow, USSR (14 Sep 1981).

A one-dimensional Lagrangian calculation of the implosion of a hydrogen gas puff is presented. At maximum compression, 60% of the mass is located in a density spike .5 mm off the axis with a half width of 40 μm. The temperature on axis reaches 200 eV.

29720 **(UWFDM—408) Magnets for the Tandem Mirror Fusion Power Reactor WITAMIR-I.** Maurer, W.; Larbalestier, D.C.; Sviatoslavsky, I.N. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). Mar 1981. Contract AS02-78ET52048. 7p. (CONF-810340—14; DOE/ET/52048—17). NTIS, PC A02/MF A01. Order Number DE81025568.

From 7. international conference on magnet technology; Karlsrube, F.R. Germany (30 Mar 1981).

The design of the magnet system for the Tandem Mirror Fusion Power Reactor WITAMIR-I is presented. The central cell of this reactor consists of 34 dc solenoid magnets with a diameter of about 8 m, spaced over a length of 165 m; the central cell magnetic field is 3.6 T. The design of these magnets is relatively simple. The requirements of the end plug magnets are more stringent. In our concept each end plug consists of one barrier mirror solenoid coil, of 3.4 m inner diameter, producing an on axis field of 14 T, two transition coils and a yin-yang pair with a maximum plug field of 6 T and a plug mirror ratio of 1.5. NbTi can be used for all coils except the high field plug solenoid for which Nb_3Sn is needed.

29721 **(WFPS-TME—80-011) Packed-fluidized-bed blanket concept for a thorium-fueled commercial tokamak hybrid reactor.** Chi, J.W.H.; Miller, J.W.; Karbowski, J.S.; Chapin, D.L.; Kelly, J.L. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Fusion Power Systems Dept.). Sep 1980. Contract AC02-77ET52043. 64p. NTIS, PC A04/MF A01. Order Number DE81024426.

A preliminary design of a thorium blanket was carried out as a part of the Commercial Tokamak Hybrid Reactor (CTHR) study. A fixed fuel blanket concept was developed as the reference CTHR blanket with uranium carbide fuel and helium coolant. A fixed fuel blanket was initially evaluated for the thorium blanket study. Subsequently, a new type of hybrid blanket, a packed-fluidized bed (PFB), was conceived. The PFB blanket concept has a number of unique features that may solve some of the problems encountered in the design of tokamak hybrid reactor blankets. This report documents the thorium blanket study and describes the feasibility assessment of the PFB blanket concept.

29722 **X-radiographic studies of ablatively driven relativistic electron beam targets.** Chang, J.; Fehl, D.L.; Widner, M.M.; Bieg, K.W.; Palmer, M.A. (Sandia National Laboratories, Albuquerque, New Mexico 87185). DE-AC04-76-DP00789. *Applied Physics Letters ;* **39**: No. 3, 224-226(1 Aug 1981).

Studies of ablatively driven, relativistic electron beam target implosions have been made with a two-frame, 3-ns exposure flash, x-radiography system. The spherical targets were filled with 200 atm of deuterium gas and had a copper shell thickness greater than the electron range. In addition, the copper shell was lined with a thin gold layer which permitted direct radiographic observations of the Au liner, achieving thereby direct observation of the pusher fuel boundary. The gold liner was observed to implode at a radial velocity of 2 x 10^8 cm/s, while maintaining better than a +- 7% variation in radial position. From the measured convergence ratio we have inferred a maximum fuel density, in the compressed state, of greater than several times solid density.

29723 **Proton beam-target interaction at pellet fusion power densities.** Peleg, E.; Zinamon, Z. (Laboratory of Plasma Studies, Cornell University, Ithaca, New York 14853). *Physics of Fluids ;* **24**: No. 8, 1527-1531(Aug 1981).

The interaction of proton beams at pellet fusion power densities (~100 TW/cm²) with initially solid targets is calculated. Radiation losses and conduction are shown to have important effects at these power densities.

29724 **Laser fusion experiments, facilities, and diagnostics at Lawrence Livermore National Laboratory.** Ahlstrom, H.G. (Lawrence Livermore National Laboratory, P.O.Box 5508, Livermore, California 94550). W-7405-ENG-48. *Applied Optics ;* **20**: No. 11, 1902-1925(1 Jun 1981).

The progress of the LLNL Laser Fusion Program in our work to achieve high gain thermonuclear microexplosions is discussed. Many experiments have been successfully performed and diagnosed using the large complex twenty-beam 30-TW Shiva laser system. A 400-kJ design of the twenty-beam Nova laser has been completed. The construction of the first phase of this facility has begun. The first phase of this Nd-doped low nonlinear index glass laser will consist of ten beams producing 100 kJ in 1-nsec pulses. One beam of the Argus laser has been converted to operation at 532 nm with 10-cm aperture. It will soon operate at 355 nm, also at 10-cm aperture. Frequency conversion crystals are being procured for full aperture operation at either 532 or 355 nm for both Argus beams. We also discuss new diagnostic instruments which provide us with new and improved resolution, information on laser absorption and scattering, thermal energy flow, supra-thermal electrons and their effects, and final fuel conditions. We have made measurements on the absorntion and Brillouin scattering for target irradiations at both 1.064 μm and 532 nm. These measurements confirm the expected increased absorption and reduced scattering at the shorter wavelength. Additional data have been obtained on the angular distribution of suprathermal x rays, which further confirms our observation of its nonisotropy. However, we do not yet have an explanation of the phenomena. Implosion experiments have been performed which have produced final fuel densities over the 10—100 x range liquid deuterium-tritium (DT) density. The 100 x achievement is the highest yet achieved in laser fusion DT fuel targets.

29725 **Thermal-shock- and fatigue-resistant coatings for magnetically confined fusion environments.** Mattox, D.M.; Mullendore, A.W.; Whitley, J.B.; Pierson, H.O. (Sandia Lab, Albuquerque, NM). *Thin Solid Films ;* **73**: No. 1, 101-107(3 Nov 1980). (CONF-800439—).

From International conference on metallurgical coatings; San Diego, CA, USA (21 Apr 1980).

Candidate coating systems of materials of low atomic number Z under development for fusion reactor applications were exposed to a maximum of 1000 cycles of electron beam pulse heating at 2 kW cm/sup -2/ for 1.5 s. The coating/substrate systems investigated include chemically vapor-deposited TiB/sub 2//graphite, chemically vapor-deposited TiC/graphite, chemically vapor-deposited B/graphite, plasma-sprayed TiB/sub 2//Cu, clad V/Cu, clad Ti/Cu and clad plus borided VB/sub 2//V/Cu. Results are discussed. 18 refs.

29726 **Optical coatings for laser fusion applications.** Lowdermilk, W.H.; Milam, D.; Rainer, F. (Lawrence Livermore Lab, CA). *Thin Solid Films ;* **73**: No. 1, 155-166(3 Nov 1980).

A review of the optical coating applications for each fusion laser system is given. Laser design issues related to coatings are presented. The importance of laser-induced damage to coatings and the status of damage experiments is discussed. Promising areas for future development are reviewed.

29727 High band gap oxide optical coatings for 0.25 and 1.06 /mu/m fusion lasers. Pawlewicz, W.T.; Hays, D.D.; Martin, P.M. (Battelle, Richland, WA). *Thin Solid Films ;* **73**: No. 1, 169-175(3 Nov 1980).

Optical coatings of the high band gap oxides ZrO/sub 2/, Y/sub 4/Al/sub 2/O/sub 9/,Al/sub 2/O/sub 3/,MgAl/sub 2/O/sub 4/ and SiO/sub 2/ were prepared by reactive sputtering to evaluate their potential for use in fusion lasers operating at wavelengths ranging from the UV to the near IR. The optical properties (refractive index, band gap, absorption and scattering) and materials properties (crystalline structure, grain size, stoichiometry and surface topography) of these oxides are reported and their suitability for use at 0.25 and 1.06 /mu/m is discussed. The deposition rates and the influences of deposition conditions on the optical and materials properties are also reported. 11 refs.

29728 Testing of low-z-coated limiters in tokamak fusion devices. Whitley, J.B.; Mullendore, A.W.; Langley, R.A. (Sandia Lab, Albuquerque, NM). *Thin Solid Films ;* **73**: No. 1, 81-90(3 Nov 1980).

Coatings of materials with low atomic number Z are being developed for application both in experimental tokamak devices such as ISX and TFTR and for possible use on various components of large power-producing controlled thermonuclear reactors. The coatings will be subjected to a severe environment and must be able to withstand physical erosion, chemical erosion, thermal shock, thermal fatigue and arcing without rigid degradation or loss of adhesion. Extensive testing on a laboratory scale was used to select the coatings most suitable for this environment. From this testing, which included pulsed electron beam heating, low energy ion bombardment and arcing, chemically vapor-deposited coatings of TiB/sub 2/ and TiC on Poco graphite substrates were selected and tested as limiters in ISX. 23 refs.

29729 VB/sub 2/: a thin film coating on vanadium for reduced tritium inventory in controlled fusion devices. Pontau, A.E.; Wilson, K.L. (Sandia Lab, Livermore, CA). *Thin Solid Films ;* **73**: No. 1, 109-114(3 Nov 1980).

Vanadium and VB/sub 2/ are among the low to moderate atomic number refractory materials being studied in the tokamak fusion test reactor tokamak flexibility modifications program for use as coatings on limiters and neutral beam protective armor. Here results are presented of (1) re-emission measurements during deuterium implantation and (2) the subsequent linear ramp thermal desorption measurements or (3) the D(/sup 3/He, /alpha/)p nuclear reaction profiling in vanadium clad to copper with and without a VB/sub 2/ coating. It is found tht VB/sub 2/ serves as a protective coating which results in a substantial reduction in deuterium retention. 7 refs.

29730 Motion following isochoric heating of concentric liquid annuli. Glenn, L.A. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). *Nuclear Engineering and Design ;* **60**: No. 3, 327-337(Oct 1980).

When adjacent liquid slabs are separated by void gaps and suddenly heated throughout, each slab will split into two parts, which then move away from each other. If there are n initial gaps, there will eventually be at least n(n + 1)/2 collisions. If the initial heating is non-uniform, the collisions will act to smear or average out the momentum generated within the fluid. Moreover, if the flow field is divergent, cavities will form in the liquid, the collisions will be inelastic, and energy will be dissipated. These phenomena were studied in connection with the design of an inertial confinement fusion reactor in which an array of concentric liquid lithium annuli, or close-packed jets, is suddenly penetrated by high-energy neutrons and simultaneously exposed to surface deposition of x-ray and ionic debris. It is shown that such a design can be very effective in reducing the outward-directed momentum and thus the impulse imparted to the reactor walls.

29731 Experimental study of the Pb and Bi breeding zones effect on the neutron parameters of a molten-salt blanket in a fusion reactor. Novikov, V.M.; Sheehov, S.B.; Romodanov, V.L.; Zagryadsky, V.A.; Chuvilin, D.Yu. (I.V. Kurchatov Inst of At Energy, Moscow, USSR). *Nuclear Instruments and Methods ;* **173**: No. 3, 449-452(15 Jul 1980).

The fluoride salt melt of Li, Be, U and Th is considered as one of the possible coolants both for a "clean" and for a "hybrid" fusion reactor. This article is devoted to the experimental study of the Pb and Bi neutron multiplication zones in the molten-salt blanket model, consisting of an aluminium sphere, filled with a eutectical mixture of LiF and BeF/sub 2/. It was experimentally shown that there is a noticeable influence of the Pb and Bi multiplication zones on the fission rates of /sup 232/Th and /sup 235/U. The spacial distribution of the fission rates of /sup 232/Th and /sup 235/U measured in this experiment was compared with that calculated by means of the program "BLANK". This comparison showed good agreement between experimental and calculated values at a large distance from the neutron source and a noticeable distinction near it. It was also shown that the experimental value of the Pb influence was larger by an average 15% for /sup 232/Th and less by an average 10% for /sup 235/U, than that calculated. 10 refs.

29732 (LA-tr—81-3) Effect of low-temperature reactor irradiation on organic insulators in superconducting magnets (I). Kato, T.; Takamura, S. Translated from *Teion Kogaku ;* **13**: No. 5, 243-249(1978). 17p. NTIS, PC A02/MF A01.

Several organic insulators in superconducting magnets for fusion reactors are irradiated in a fission reactor at 5K and their mechanical properties are measured at liquid nitrogen temperature 77K. After irradiation with fast neutron fluence of 1.7 x 10^{17} nvt and γ dose of 4.5 x 10^{8} R, polypropylene is broken into pieces and polycarbonate and Mylar becomes too brittle to permit tensile test. Breaking stress and elongation of Nomex reduce as compared with that of unirradiated specimen. Kapton exhibits only a little decrease in breaking stress after irradiation of fast neutron fluence of 3.3 x 10^{17} nvt and γ dose of 8.8 x 10^{8} R, and shows the most excellent properties against the irradiation.

99 GENERAL AND MISCELLANEOUS

9901 Management

REFER ALSO TO CITATION(S) 28757, 29747

29733 (CONF-801038—(Vol.2), pp 1305-1307) **Review of the activities of the OECD Nuclear Energy Agency associated with air cleaning technology.** Olivier, J.P. (OECD Nuclear Energy Agency, Paris, France). Feb 1981. NTIS, PC A99/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

The Nuclear Energy Agency of the OECD (NEA) is an intergovernmental organization whose primary objective is to promote co-operation between its 23 Member countries on various aspects of nuclear development, notably on safety and regulation matters. NEA does not conduct any research or development work, its role being essentially to assist Member countries with regard to safety, radiation protection and waste management problems, by collecting and disseminating technical information, discussing and evaluating R & D results and when possible, coming up with broadly accepted views and guidance on specific issues. Some of the work carried out by NEA are: (1) prepared the report Radiological Significance and Management of Tritium, Carbon-14, Krypton-85, Iodine-129, Arising from the Nuclear Fuel Cycle; (2) assessed the various codes used to model the consequences of nuclear accidents: (3) published State-of-the-Art Report on the Role of Nuclear Aerosols in Reactor Safety; (4) organized with the cooperation of ORNL and the US Nuclear Regulatory Commission, a specialist meeting on the subject of nuclear aerosols, held in Gatlinburg, Tennessee; (5) organized a specialist meeting on the impact of accident situations on air cleaning and filtration systems held in the Federal Republic of Germany; and (6) carried out an inquiry on the monitoring of airborne radioactive effluents.

29734 (GEPP-OP—552) Use of word processing in preparing a contamination control training manual. McGirr, C.J. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 1981. Contract AC04-76DP00656. 4p. (CONF-810505—4). NTIS, PC A02/MF A01. Order Number DE81026613.

From Institute of Environmental Sciences annual meeting; Los Angeles, CA, USA (4 May 1981).

Word processing equipment makes it possible for an instructor to efficiently create a variety of training manuals slanted toward the wide variations in background and experience of class members. Such manuals aid in more efficient use of classroom and student time and effort. Manual preparation time may be reduced as much as 90%.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 28050, 28813, 29144, 29183, 29283, 29435, 29571

29735 (ANL—81-40) Applied mathematical sciences research at Argonne, April 1, 1980-March 31, 1981. Pieper, G.W. (ed.). (Argonne National Lab., IL (USA)). 1981. Contract W-31-109-ENG-38. 41p. NTIS, PC A03/MF A01. Order Number DE81027468.

This report reviews the research activities of the Applied Mathematical Sciences Section for the period April 1, 1980, through March 31, 1981. The body of the report discusses various projects carried out in three major areas of research: applied analysis, computational mathematics, and software engineering. Information on section staff, visitors, workshops, and seminars is found in the appendices.

29736 (BNL—29654) Multiple-user data acquisition and analysis system. Manzella, V.; Chrien, R.E.; Gill, R.L.; Liou, H.I.; Stelts, M.L. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 3p. (CONF-810523—8). NTIS, PC A02/MF A01. Order Number DE81026056.

From Topical conference on computerized data acquisition in particle and nuclear physics; Oak Ridge, TN, USA (28 May 1981).

The nuclear physics program at the Brookhaven National Laboratory High Flux Beam Reactor (HFBR) employs a pair of PDP-11 computers for the dual functions of data acquisition and analysis. The data acquisition is accomplished through CAMAC and features a microprogrammed branch driver to accommodate various experimental inputs. The acquisition computer performs the functions of multi-channel analyzers, multiscaling and time-sequenced multichannel analyzers and gamma-ray coincidence analyzers. The data analysis computer is available for rapid processing of data tapes written by the acquisition computer. The ability to accommodate many users is facilitated by separating the data acquisition and analysis functions, and allowing each user to tailor the analysis to the specific requirements of his own experiment. The system is to be upgraded soon by the introduction of a dual port disk to allow a data base to be available to each computer.

29737 (CONF-810546—4) Workshop on system tuning, performance measurement and performance optimization of an RSX11M system. Downward, J.G. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 20 May 1981. Contract AC08-78DP40030. 9p. NTIS, PC A02/MF A01. Order Number DE81025596.

From 1981 spring DECUS U.S. symposium; Miami Beach, FL, USA (18 May 1981).

Topics discussed include thrashing in an RSX11M system - what to do; using solid state disk emulators as the swapping device - performance improvement, performance measurement techniques; capacity planning; bis buffering; and DECNET-11M optimization - performance that can be expected for real environments.

29738 (DOE/ER/70019—T1) Invariant imbedding and the reduction of boundary-value problems of thin-plate theory to Cauchy formulations. Angel, E.; Distefano, N.; Jain. A. (University of Southern California, Los Angeles (USA). Dept. of Electrical Engineering). Aug 1970. Contract AT03-76ER70019. 20p. NTIS, PC A02/MF A01. Order Number DE81026104.

Using ideas of invariant imbedding, a classical elliptic boundary value problem, namely the biharmonic equation in a rectangular domain, is reduced to a Cauchy formation, i.e., to an initial value problem. The theory is developed in the contex of elementary thin plate theory. It is shown that a rectangular plate with three edges clamped and the fourth edge free can be completely described by a system of integro-differential equations subject to initial values. The functions defined by these equations are intimately related to the Green's function of the plate. The Betti reciprocity relations are proved in the context of the present theory and some applications of the fundamental solution are considered. It is finally shown that the present Cauchy system can generate a variety of novel numerical schemes including those previously developed.

29739 (DOE/ER/70019—T3) Initial-value transformations for elliptic boundary-value problems. Angel, E.; Jain, A. (University of Southern California, Los Angeles (USA). Dept. of Electrical Engineering). May 1970. Contract AT03-76ER70019. 12p. NTIS, PC A02/MF A01. Order Number DE81026105.

The solution of elliptic boundary value problems is considered through the use of an initial value transformation. While the original boundary value problem usually has unfavorable stability properties, the transformed problem can usually be handled in a direct manner. The transformation is shown to lead to the standard numerical techniques and also suggests many new methods.

29740 (DOE/ER/70019—T4) One-sweep numerical method for vector-matrix difference equations with two-point boundary conditions. Angel, E.; Kalaba, R. (University of Southern California, Los Angeles (USA). Dept. of Electrical Engineering). Apr 1970. Contract AT03-76ER70019. 17p. NTIS, PC A02/MF A01. Order Number DE81024199.

A new method is proposed for reducing two point boundary value problems for vector-matrix systems of linear difference equations to initial value problems. The method has the advantage that only one sweep is required, and memory requirements are minimal. Applications to potential theory are discussed.

29741 (DOE/ER/70019—T5) Differential quadrature and long-term integration. Bellman, R.; Casti, J. (University of Southern California, Los Angeles (USA); RAND Corp., Santa Monica, CA (USA)). Mar 1970. Contract AT03-76ER70019. 7p. NTIS, PC A02/MF A01. Order Number DE81026124.

29742 (DOE/ER/70019—T6) Functional equations in the theory of dynamic programming. XVIII: minimum convolutions and Green's functions. Bellman, R. (University of Southern California, Los Angeles (USA)). Jan 1970. Contract AT03-76ER70019. 5p. NTIS, PC A02/MF A01. Order Number DE81026155.

29743 (DOE/ER/70019—T7) Functional equations in the theory of dynamic programming. XVII: policies dependent on critical-state variables. Bellman, R. (University of Southern California, Los Angeles (USA)). Dec 1969. Contract AT03-76ER70019. 6p. NTIS, PC A02/MF A01. Order Number DE81026154.

29744 (DOE/ER/70019—T11) Differential quadrature and long-term integration. Bellman, R.; Casti, J. (University of Southern California, Los Angeles (USA); RAND Corp., Santa Monica, CA (USA)). Jan 1970. Contract AT03-76ER70019. 7p. NTIS, PC A02/MF A01. Order Number DE81026138.

29745 (DOE/ER/70019—T12) Approximation techniques in discrete dynamic programming. Lew, A. (University of Southern California, Los Angeles (USA). Dept. of Electrical Engineering). Jan 1970. Contract AT03-76ER70019. 106p. NTIS, PC A06/MF A01. Order Number DE81026125.

A study of general techniques for obtaininig approximate solutions to discrete dynamic programming functional equations is reported herein. The motivation for this study is that exact solutions to such equations are in general impossible to obtain due to analytical complexities, and that numerical solutions are computationally

intractable because of excessive computer storage requirements. The primary alternatives are (a) to resort to different but equivalent formulations, all of which have afflictions of their own, or (b) to remain within the discrete dynamic programming framework and endeavor to surmount the dimensionality barrier. The latter choice is adopted here.

29746 **(DOE/ER/70019—T13) Matrix initial-value methods for the biharmonic equation.** Angel, E. (University of Southern California, Los Angeles (USA). Dept. of Electrical Engineering). May 1970. Contract AT03-76ER70019. 18p. NTIS, PC A02/MF A01. Order Number DE81026153.

Problems arising in many fields lead to the necessity of obtaining numerical solutions of the biharmonic equation, a fourth order elliptic equation. Two finite difference methods are proposed for solving this equation numerically under various boundary conditions. The first method is based upon the Riccati transformation while the second is based on the theory of invariant imbedding. Both methods yield stable initial value problems which can easily be handled on any modern digital computer.

29747 **(DOE/ER/70214—T1) Energy Research and Development Administration Ad Hoc Computer Networking Group: experimental program.** Cohen, I. (California Univ., Los Angeles (USA)). 19 Mar 1975. Contract AT03-76ER70214. 76p. NTIS, PC A05/MF A01.

The Ad Hoc Computer Networking Group was established to investigate the potential advantages and costs of newer forms of remote resource sharing and computer networking. The areas of research and investigation that are within the scope of the ERDA CNG are described. (GHT)

29748 **(DOE/RA/50259—T1) Information processing in man-machine systems.** Sen, P.; Drenick, R.F. (Polytechnic Inst. of New York, Brooklyn (USA); Polysystems Analysis Corp., Huntington, NY (USA)). 1980. Contract AC01-80RA50259. 19p. NTIS, PC A02/MF A01. Order Number DE81025134.

The human decision maker in an organization can be treated as an adaptive information channel (i.e. a channel with non-constant processing times), especially in high data rate environments such as C^3 systems. This paper develops a framework for treating information transmission through such adaptive channels and presents some basic results. A model of a human decision maker in an organization is also developed within this framework.

29749 **(EGG—1183-1804) Engineering Analysis System (EASY).** Rebentisch, S.D. (EG and G, Inc., Las Vegas, NV (USA). Energy Measurements Group). 4 Jul 1981. Contract AC08-76NV01183. 68p. NTIS, PC A04/MF A01. Order Number DE81027508.

This manual describes the software for the Engineering Analysis System (EASY). It contains descriptions and operating instructions for sub-systems divided into chapter categories. The EASY system was originally set up for the purpose of calibrating and keeping track of the transducer inventory. Its capabilities have now grown to include the channel listings. These capabilities have increased the amount of software on this sytem by more than double the original design. The EASY system will eventually talk directly to the processor back in Los Alamos (WX-10) and the Front End Systems (trailers) in the forward area. The EASY computer is a PDP 11/34 running on an RSX-11M operating system.

29750 **(LA—8849-MS) Philosophy of supercomputing.** Worlton, J. (Los Alamos Scientific Lab., NM (USA)). Jun 1981. Contract W-7405-ENG-36. 32p. NTIS, PC A03/MF A01. Order Number DE81028586.

A critical examination of some of the commonly held beliefs about supercomputing, including basic problems, principles, and motivating concepts, is presented.

29751 **(LA—8887-MS) Network file storage system.** Christman, R.D.; Collins, M.W.; Devaney, M.A.; Willbanks, E.W. (Los Alamos National Lab., NM (USA)). Jul 1981. Contract W-7405-ENG-36. 17p. NTIS, PC A02/MF A01. Order Number DE81028542.

The Common File System (CFS) is a large, online centralized storage system for the Los Alamos National Laboratory's computer network. The CFS provides Los Alamos computer users a relatively simple set of primitives with which they can store and retrieve files. A tree-structured directory allows the users to organize their data in a logical and reasonable manner. Eighteen months of operational experience and statistics have provided considerable insight into the best methods of providing optimum service and response to CFS users. Automatically moving, or migrating, files between storage devices based on usage characteristics has provided a cost-effective storage system.

29752 **(LA—8902-MS) VAX/VMS benchmarking.** Creel, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1981. Contract W-7405-ENG-36. 20p. NTIS, PC A02/MF A01. Order Number DE81028599.

Primary emphasis in this report is on the performance of three Digital Equipment Corporation VAX-11/780 computers at the Los Alamos National Laboratory. Programs used in the study are part of the Laboratory's set of benchmark programs. The VAX-11/780 computers each had slightly different configurations that affected the performance of several of the benchmarks. Execution times of these programs on the VAX-11/780s are also compared to those on the Control Data Corporation (CDC) 6600 and Cyber 73 computers.

29753 **(LA—8903-MS) Some new multivariate distributions with enhanced comparisons via contour and three-dimensional plots.** Johnson, M.E.; Bryson, M.C.; Mills, C.F. (Los Alamos National Lab., NM (USA)). Jul 1981. Contract W-7405-ENG-36. 60p. NTIS, PC A04/MF A01. Order Number DE81026440.

Some new continuous multivariate probability distributions are illustrated with contour and three-dimensional plots. These distributions are developed by Bryson and Johnson and are based on a construction scheme employing Khintchine's Theorem.

29754 **(LA-UR—81-45) Experiences in the design and support of a graphics-deivce-driver interface.** Reed, T.N. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 12p. (CONF-810901—1). NTIS, PC A02/MF A01.

From EUROGRAPHICS '81 conference; Darmstadt, F.R. Germany (9 Sep 1981).

The Common Graphics System (CGS) was developed at the Los Alamos National Laboratory and has been in use since early 1977. A standard device driver interface was defined for graphics device drivers and for use by user-callable graphics subroutine packages. A description of the existing CGS device driver interface, experience gained by using it, and a proposal for an extended interface capable of supporting more powerful graphics devices is given. The relationship between the CGS device driver interface and the CGS Metafile is disucssed.

29755 **(SAND—81-1041C) Use of a hybrid computer for the flight simulation of a bomb/parachute system.** Cole, J.K. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 26p. (CONF-810521—2). NTIS, PC A03/MF A01. Order Number DE81025141.

From User Society meeting for the applied dynamics system 10; Pacific Grove, CA, USA (9 May 1981).

The Flight Simulation Laboratory at Sandia National Laboratories, Albuquerque, is used primarily to study the dynamics of unguided bombs, rockets, shells, and reentry vehicles and to develop and evaluate guidance and control systems for guided vehicle concepts. This report describes the use of this laboratory for a 12 degree-of-freedom simulation of a bomb/parachute system. The simulation results are compared with data from flight tests.

29756 **(SLAC-TN—81-3) Floating point software package for use on LSI-11 computers at SLAC.** Hendra, R.G. (Stanford Linear Accelerator Center, CA (USA)). Jun 1981. Contract AC03-76SF00515. 6p. NTIS, PC A02/MF A01. Order Number DE81026229.

A floating point software package has been devised to allow full use of the floating point hardware of the LSI-11 and

MODEL40 computers. The procedures are written for the most part in the PL-11 language. The package may be run under the RT-11 operating system, or in RAM or EPROM as part of the KERNEL package. The current set of procedures has been run successfully in all three modes.

29757 **(SLAC-TN—81-4) Bridging the gap between the KERNEL and RT-11.** Hendra, R.G. (Stanford Linear Accelerator Center, CA (USA)). Jun 1981. Contract AC03-76SF00515. 15p. NTIS, PC A02/MF A01. Order Number DE81026260.

A software package is proposed to allow users of the PL-11 language, and the LSI-11 KERNEL in general, to use their PL-11 programs under RT-11. Further, some general purpose extensions to the KERNEL are proposed that facilitate some number conversions and strong manipulations. A Floating Point Package of procedures to allow full use of the hardware floating point capability of the LSI-11 computers is proposed. Extensions to the KERNEL that allow a user to read, write and delete disc files in the manner of RT-11 is also proposed. A device directory listing routine is also included.

29758 **(UCID—19097) RATFIT: a rational equation-of-state fitting program.** Fritsch, F.N. (Lawrence Livermore National Lab., CA (USA)). Mar 1981. Contract W-7405-ENG-48. 40p. NTIS, PC A03/MF A01. Order Number DE81027273.

RATFIT is a program that fits an eleven-parameter equation of state of the form $P(\mu,\epsilon) = A(\mu) + B(\mu)\epsilon + C(\mu)\epsilon^2/1 + D_0\epsilon$, where A and B are cubic polynomials and C is quadratic, to (μ, P)-data given along the Hugoniot and/or the principal adiabat. It can also include data for $\gamma = (\partial P/\partial \epsilon)/(\mu+1)$ along the adiabat. The user may weight individual points arbitrarily and may fix any (or all) of the parameters at specified values. Printed and plotted output is available along the Hugoniot and adiabat associated with the equation of state.

29759 **(UCRL—53139) Hyperchannel architecture: a case study of some inadequacies in the ISO-OSI reference model.** Nessett, D.M. (Lawrence Livermore National Lab., CA (USA)). Apr 1981. Contract W-7405-ENG-48. 29p. NTIS, PC A03/MF A01. Order Number DE81028497.

A description of the Hyperchannel architecture is given in terms of the OSI-RM. In the process, a number of deficiencies are presented both in the OSI-RM and in the Hyperchannel architecture. Finally, some suggestions are made about how the Hyperchannel architecture could be changed to provide the basis of an I/O interface standard. Investigation of these suggestions should be a key area of research before an I/O interface standard based on a broadcast-bus is proposed.

29760 **(UCRL—84479) Development of a microcomputer-based teleconference system.** Allen, R.W. (Lawrence Livermore National Lab., CA (USA)). 12 Sep 1980. Contract W-7405-ENG-48. 10p. (CONF-801265—1). NTIS, PC A02/MF A01. Order Number DE81025990.

From IEEE computer networking symposium; Gaithersburg, MD, USA (10 Dec 1980).

A computer based teleconference system was developed at the Lawrence Livermore National Laboratory (LLNL) from FY 1978 through FY 1980. The system is unique because it is based on a single low-cost microcomputer. The implementation of the system, with emphasis on the practical software issues addressed during development, is discussed.

29761 **TRIDIF, a triangular mesh diffusion code.** Freeman, J.R. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Computational Physics ;* **41**: No. 1, 142-153(May 1981).

A triangular mesh finite difference code designed to study time-dependent magnetic diffusion and eddy current problems is described. TRIDIF is an extension of an existing widely used steady-state magnet design code entitled PANDIRA. The modifications required for the standard PANDIRA difference equations are presented. Sample results incude magnetic field distributions in ion diodes and sources used for particle beam fusion applications.

9903 Information Handling

REFER ALSO TO CITATION(S) 28620, 28767, 29102

29762 **(DOE/MA—0008-5/81) Department of Energy Audit Report Tracking System. Quarterly management report as of March 31, 1981.** (Department of Energy, Washington, DC (USA). Office of the Controller). May 1981. 105p. NTIS, PC A06/MF A01. Order Number DE81025201.

This report provides information to DOE management on the status of corrective actions on audit recommendations contained in reports on audits of DOE activities, programs, and contracts. It is based on data accumulated in accordance with DOE Order 2300.1 which established a DOE Audit Report Tracking System (DARTS). The Order provides for bringing to the attention of the DOE Audit Review Council (DARC) such matters as corrective actions inordinately delayed, unresolved disagreements between the auditor and auditee, and controversial matters for action deemed appropriate.

29763 **(LBL—12492) GRAMPS: a graphics language interpreter for real-time, interactive, three-dimensional picture editing and animation.** O'Donnell, T.J.; Olson, A.J. (Lawrence Berkeley Lab., CA (USA)). Aug 1981. Contract W-7405-ENG-48. 11p. (CONF-810805—6). NTIS, PC A02/MF A01. Order Number DE81027398.

From SIGGRAPH'81 meeting; Dallas, TX, USA (3 Aug 1981).

GRAMPS, a graphics language interpreter has been developed in FORTRAN 77 to be used in conjunction with an interactive vector display list processor (Evans and Sutherland Multi-Picture-System). Several of the features of the language make it very useful and convenient for real-time scene construction, manipulation and animation. The GRAMPS language syntax allows natural interaction with scene elements as well as easy, interactive assignment of graphics input devices. GRAMPS facilitates the creation, manipulation and copying of complex nested picture structures. The language has a powerful macro feature that enables new graphics commands to be developed and incorporated interactively. Animation may be achieved in GRAMPS by two different, yet mutually compatible means. Picture structures may contain framed data, which consist of a sequence of fixed objects. These structures may be displayed sequentially to give a traditional frame animation effect. In addition, transformation information on picture structures may be saved at any time in the form of new macro commands that will transform these structures from one saved state to another in a specified number of steps, yielding an interpolated transformation animation effect. An overview of the GRAMPS command structure is given and several examples of application of the language to molecular modeling and animation are presented.

29764 **(DOE/EP—0007) Guideline for the implementation of the individual development plan.** (Department of Energy, Washington, DC (USA)). [nd]. 27p. NTIS, PC A03/MF A01. Order Number DE81027529.

This guide is designed as an aid for supervisors or managers, to assist with career planning in establishing individual development plans (IDP's) - thereby improving the SPR capability within all functional areas. In the achievement of this objective, particular emphasis should be placed on projecting and initiating planned work assignments that follow clear lines of progression to higher skills and grade levels leading successfully toward more responsible positions.

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Qualifier
Title, (supplementary information), citation number, (report number)

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

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AC03-77CS34543	**Energy Technology, Inc., Cleveland, OH (USA)**	
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AC03-78CS40005	**AiResearch Mfg. Co., Torrance, CA (USA)**	
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AC03-78CS51737	**Santa Clara Univ., CA (USA)**	
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AC03-78CS52184	**Aerospace Corp., El Segundo, CA (USA). Eastern Technical Div.**	
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AC03-78ET13090	**Talley Energy Systems, Inc., Scottsdale, AZ (USA)**	
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AC03-79ET23048	**Poly Solar, Inc., Garland, TX (USA)**	
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AC03-79ET27241	**JM Energy Consultants, Inc., Los Angeles, CA (USA)**	
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AC04-76DP00053	**Mound Facility, Miamisburg, OH (USA)**	
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AI01-80ET17088	**National Aeronautics and Space Administration, Washington, DC (USA)**	
	6:28846	DOE/NASA/0208—2
AI03-76SF70046	**General Atomic Co., San Diego, CA (USA)**	
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AI04-80AL12726	**National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center**	
	6:28847	DOE/NASA/12726—7
AI05-76EV03688	**National Oceanic and Atmospheric Administration, Rockville, MD (USA). Environmental Research Labs.**	
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AI08-76DP00351	**National Oceanic and Atmospheric Administration, Las Vegas, NV (USA). Weather Service Nuclear Support Office**	
	6:29215	NVO—233
AI08-76DP00539	**Environmental Protection Agency, Las Vegas, NV (USA)**	
	6:29224	EPA—600/4-81-035
AI21-77ET-13032	**Jet Propulsion Lab., Pasadena, CA (USA)**	
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AM01-77ET-12532	**Ketron, Inc., Wayne, PA (USA)**	
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AM02-76CH03073	**Princeton Univ., NJ (USA). Plasma Physics Lab.**	
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AM03-76SF00034	**California Univ., Davis (USA). Dept. of Chemistry**	
	6:29069	UCD—34P168-3
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AM03-76SF00115	**Stanford Research Inst., Menlo Park, CA (USA)**	
	6:28336	SRIA—115P49-1
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AM03-76SF01101	**Aerospace Corp., El Segundo, CA (USA)**	
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AM21-80MC14522	**TRW Energy Engineering Div., Morgantown, WV (USA)**	
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AS01-76ET10517	**Cincinnati Univ., OH (USA). Dept. of Chemistry**	
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AS02-76ER02119	**Case Western Reserve Univ., Cleveland, OH (USA). Div. of Metallurgy and Materials Science**	
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AS02-76ER02390	**Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering**	
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AS02-76ER02712	**Pennsylvania State Univ., University Park (USA)**	
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AS02-76ER03126	**Brooklyn Coll., NY (USA). Dept. of Chemistry**	
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AS02-76ER03230	**Brandeis Univ., Waltham, MA (USA). Dept. of Physics**	
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AS02-76ER03244	**Carnegie-Mellon Univ., Pittsburgh, PA (USA)**	
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AS02-76ER03533	**Syracuse Univ., NY (USA). Dept. of Physics**	
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AS02-76ET28320	**Brown Univ., Providence, RI (USA)**	
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AS02-76ET52040	**Illinois Univ., Urbana (USA). Fusion Studies Lab.**	
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AS02-76EV03333	**Massachusetts General Hospital, Boston (USA)**	
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AS02-76EV03335	**Massachusetts General Hospital, Boston (USA). Radiology Research Lab.**	
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AS02-76EV03382	**New York Univ., NY (USA). Medical Center**	
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AS02-76EV03419	**Pennsylvania State Univ., University Park (USA)**	
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AS02-76EV03571	**Yale Univ., New Haven, CT (USA)**	
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AS02-76EV04047	**Rhode Island Univ., Kingston (USA). University Energy Center**	
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AS02-76EV04078	**Yale Univ., New Haven, CT (USA). Dept. of Diagnostic Radiology**	
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AS02-76EV12195	**Massachusetts Inst. of Tech., Cambridge (USA)**	
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AS02-77ET53053	**Yale Univ., New Haven, CT (USA)**	
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AS02-77EV04267	**Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nutrition and Food Science**	
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AS02-77EV04498	**Maine Univ., Orono (USA). Land and Water Resources Inst.**	
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AS02-78ER05002	**Massachusetts Inst. of Tech., Cambridge (USA)**	
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AS02-78ER05007	**Delaware Univ., Newark (USA). Bartol Research Foundation**	
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AS02-78ER05031	**Amherst Coll., MA (USA)**	
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AS02-78ET51002	Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center	
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AS02-78ET52048	Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering	
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AS02-78EV04957	New York Univ., NY (USA). Medical Center	
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AS02-78EV04964	Pennsylvania State Univ., University Park (USA)	
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AS02-79ER10393	Colorado School of Mines, Golden (USA)	
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AS02-79ER10443	Northeastern Univ., Boston, MA (USA)	
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AS02-79ER10457	Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Chemistry	
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AS03-76SF01123	AiResearch Mfg. Co., Phoenix, AZ (USA)	
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AS05-76EV03941	Duke Univ., Durham, NC (USA). Dept. of Biochemistry	
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AS05-80ER10655	Florida State Univ., Tallahassee (USA)	
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AS07-80CS40361	Purdue Univ., Lafayette, IN (USA). Purdue Lab. for Applied Industrial Control	
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AS09-76ER00884	South Carolina Univ., Columbia (USA). Coll. of Engineering	
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AS19-79BC10007	Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Chemical Engineering	
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AT01-76ET10696	Massachusetts Inst. of Tech., Cambridge (USA)	
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AT02-76CH91005	Combustion Engineering, Inc., Windsor, CT (USA)	
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AT03-76CS51101	Aerospace Corp., El Segundo, CA (USA). Energy and Transportation Div.	
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AT03-76ER70019	University of Southern California, Los Angeles (USA). Dept. of Electrical Engineering	
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AT03-76ER70149	California Univ., Irvine (USA). Dept. of Physics	
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AT03-76ER70214	California Univ., Los Angeles (USA)	
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AT03-76ET12075	California Univ., Los Angeles (USA)	
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AT03-76ET35301	General Atomic Co., San Diego, CA (USA)	
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AT03-76EV74010	Aerospace Corp., Germantown, MD (USA)	
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AT03-76SF10046	General Atomic Co., San Diego, CA (USA)	
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AT03-76SF70010	Foster Wheeler Corp., Livingston, NJ (USA). Nuclear Dept.	
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AT03-76SF71053	General Atomic Co., San Diego, CA (USA)	
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AT03-76SF72024	General Electric Co., Sunnyvale, CA (USA)	
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AT03-76SF73002	General Electric Co., Sunnyvale, CA (USA). Energy Systems and Technology Div.	
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AT03-76SF76026	Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group	
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AT03-76SF90467	TRW Systems Group, McLean, VA (USA)	
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AT03-76SF90478	TRW Systems Group, McLean, VA (USA)	
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AT03-76SF90481	TRW, Inc., McLean, VA (USA). Energy Systems Planning Div.	
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AT03-76SF98001	Borg-Warner Corp., Carson, CA (USA). Byron Jackson Pump Div.	
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AT03-80SF11512	General Atomic Co., San Diego, CA (USA)	
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AT06-80ER10680	Washington Univ., Seattle (USA)	
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EX-76-C-01-2295-027	Massachusetts Inst. of Tech., Cambridge (USA)	
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FC01-78CS35210	Belz Investment Co., Memphis, TN (USA)	
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FC01-78CS35211	ARC Associates, Arlington, VA (USA)	
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FC01-80ET23197	Semix, Inc., Gaithersburg, MD (USA)	
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FC02-80CS30584	Syracuse Research Corp., NY (USA). Energy Research Center	
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FC03-78ET27163	Systems, Science and Software, La Jolla, CA (USA)	
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FC03-79ET27194	GRIPS Commission, Santa Rosa, CA (USA)	
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FC03-79ET27196	Imperial, County of, El Centro, CA (USA). Dept. of Public Works	
	6:28506	DOE/ET/27196—T3
FC03-80RA50239	San Diego Gas and Electric Co., CA (USA)	
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FC03-80SF11505	Trinity Univ., San Antonio, TX (USA)	
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FG01-77CS31632	**Day's Inn of America, Inc., Atlanta, GA (USA)**	
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FG01-79RA20219	**Northern Resources, Inc., Billings, MT (USA)**	
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FG01-79RA20222	**Philadelphia Gas Works, PA (USA)**	
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FG01-79RA20223	**New York State Energy Research and Development Authority, Albany (USA)**	
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FG01-80RA50135	**AmeriGas, Inc., Valley Forge, PA (USA)**	
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FG01-81FE05110	**New York State Energy Research and Development Authority, Albany (USA)**	
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FG02-79CS30292	**Wisconsin Center for Public Policy, Madison (USA)**	
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FG02-80R510236	**Jacobs Energy Research, Inc., Audubon, MN (USA)**	
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FG03-77ET12005	**Jeppson (Morris R.), Carmel, CA (USA)**	
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FG03-78ET27152	**California Energy Resources Conservation and Development Commission, Sacramento (USA)**	
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FG03-78SF01795	**National Conference of State Legislatures, Denver, CO (USA)**	
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FG03-78SF01978	**Farallones Inst., Occidental, CA (USA)**	
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FG03-78SF01979	**McWhorter (Edward M.), Citrus Heights, CA (USA)**	
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FG03-78SF02006	**Hastrup (Herman), Kaneohe, HI (USA)**	
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FG22-80PC30220	**State Univ. of New York, Buffalo (USA). School of Engineering and Applied Science**	
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FG22-80PC30230	**Colorado School of Mines, Golden (USA). Dept. of Chemical and Petroleum Refining Engineering**	
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FG22-80PC30235	**Southern Illinois Univ., Carbondale (USA)**	
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FG22-80PC30243	**Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering**	
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FG22-80PC30247	**Louisiana State Univ., Baton Rouge (USA)**	
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FM07-80ID49004	**Nevada Irrigation District, Grass Valley, CA (USA)**	
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NAS-7-100-955382	**Massachusetts Inst. of Tech., Cambridge (USA)**	
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NAS-7-100-955787	**Science Applications, Inc., McLean, VA (USA)**	
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NAS-7-100-955893	**AIA Research Corp., Washington, DC (USA)**	
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CONF-8007107-		(International symposium on the human side of energy, Laramie, WY, USA, 7-9 Jul 1980)
2	6:28153	NTIS, PC A03/MF A01. Order Number DE81025177, Distribution Category MN -90i
CONF-8007109-		(Combustion turbine residual oil workshop, Atlanta, GA, USA, 17-18 Jul 1980)
	6:28596	*See* EPRI-WS-80-132
	6:28597	*See* EPRI-WS-80-132
	6:28598	*See* EPRI-WS-80-132
	6:28599	*See* EPRI-WS-80-132
	6:28600	*See* EPRI-WS-80-132
	6:28601	*See* EPRI-WS-80-132
	6:28602	*See* EPRI-WS-80-132
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	6:28604	*See* EPRI-WS-80-132
	6:28605	*See* EPRI-WS-80-132
CONF-800804-		(ASME century 2 emerging technology conference, San Francisco, CA, USA, 10-22 Aug 1980)
42	6:28750	NTIS, PC A02/MF A01. Order Number DE81024256, Distribution Category MN -94cc
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2	6:29570	*See* IS-M-297
CONF-800864-		(International conference on physics of transition metals, Leeds, UK, 18-22 Aug 1980)
3	6:28942	NTIS, PC A02/MF A01. Order Number DE81023110, Distribution Category MN -34
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2	6:28665	NTIS, PC A02/MF A01. Order Number DE81023137, Distribution Category MN -79p
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1	6:28751	NTIS, PC A03/MF A01. Order Number DE81023104, Distribution Category MN -94ca
CONF-800918-		(International solvent extraction conference, Liege, Belgium, 6-12 Sep 1980)
6	6:29046	*See* DOE/ER/03126-40
CONF-800989-		(International Association of Hydraulic Research cooling tower workshop, San Francisco, CA, USA, 21-25 Sep 1980)
2	6:29208	NTIS, PC A03/MF A01. Order Number DE81023834, Distribution Category MN -12
CONF-8009131-		(NATO International Advanced Study Institute on Molecular ions: geometric and electronic structures, Kos, Greece, 30 Sep-10 Oct 1980)
2	6:29413	NTIS, PC A05/MF A01. Order Number DE81023898, Distribution Category MN -34A
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	6:29178	*See* BNL-28832
	6:29181	*See* BNL-28832
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	6:29377	*See* BNL-28832
	6:29396	*See* BNL-28832
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	6:29556	*See* BNL-28832
	6:29564	*See* BNL-28832

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24	6:28878	*See* IS-M-351
25	6:28473	*See* IS-M-352
26	6:28877	*See* IS-M-333
CONF-801037-	(American Vacuum Society conference, Detroit, MI, USA, 13-17 Oct 1980)	
9(Rev.1)	6:28341	*See* UCRL-84488(Rev.1)
CONF-801038-	(16. DOE nuclear air cleaning conference, San Diego, CA, USA, 20-23 Oct 1980)	
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4	6:28987	*See* RFP-3106
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12	6:28753	*See* LBL-11090
CONF-8010198-	(Conference on climate and offshore energy resources, London, UK, 21-23 Oct 1980)	
2	6:29204	*See* DOE/EV/12195-41
CONF-8010201-	(Workshop on deposition in utility gas turbines, Palo Alto, CA, USA, 30-31 Oct 1980)	
	6:28595	*See* EPRI-WS-80-121
CONF-8010203-	(Heavy ion fusion workshop, Berkeley, CA, USA, 29 Oct-9 Nov 1980)	
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2	6:29665	NTIS, PC A02/MF A01. Order Number DE81023846, Distribution Category MN -21
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1	6:28917	NTIS, PC A02/MF A01. Order Number DE81023908, Distribution Category MN -95f
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1	6:29666	NTIS, PC A02/MF A01. Order Number DE81023905, Distribution Category STD -21
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60	6:29229	*See* RHO-SA-181
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7	6:29620	*See* UCRL-84854
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51	6:29372	*See* RHO-BWI-SA-77
52	6:28305	*See* RHO-BWI-SA-76
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3	6:29151	*See* PNL-SA-8768
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1	6:29760	*See* UCRL-84479
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1	6:29681	*See* HEDL-SA-2226
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6	6:29621	*See* UCRL-85227
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18	6:28307	*See* RHO-BWI-SA-90
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14	6:29720	*See* UWFDM-408
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3	6:29189	*See* LBL-12678
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2	6:29595	*See* LBL-12688
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3	6:29470	NTIS, PC A02/MF A01. Order Number DE81025151, Distribution Category MN -34D
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3	6:29458	*See* LBL-12814
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1	6:29582	*See* BNL-29719
2	6:29488	*See* LBL-12852
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8	6:28691	*See* GA-A-16212
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34	6:29685	*See* LA-UR-81-1750
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5	6:28178	*See* LBL-12063
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9	6:29173	*See* BNL-29612
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2	6:28438	*See* SAND-81-1546C
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2	6:28916	*See* BNL-29720
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2	6:28721	*See* BNL-29632
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2	6:29487	*See* LBL-12826
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1	6:29346	NTIS, PC A03/MF A01. Order Number DE81023187, Distribution Category MN -48
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1	6:29347	NTIS, PC A03/MF A01. Order Number DE81023189, Distribution Category MN -48
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1	6:29316	*See* BNL-29631
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4	6:29734	*See* GEPP-OP-552
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8	6:29736	*See* BNL-29654
9	6:29715	*See* UCRL-85669
CONF-810526-	(15. IEEE PV specialists conference, Orlando, FL, USA, 11-15 May 1981)	
30	6:28399	*See* SERI/TP-611-1226
32	6:28400	*See* SERI/TP-611-1231
33	6:28404	*See* SERI/TP-623-1164
35	6:28402	*See* SERI/TP-614-1216
36	6:28401	*See* SERI/TP-613-1225
37	6:28403	*See* SERI/TP-614-1235
38	6:28370	*See* BNL-29668
CONF-810527-	(International conference on plasma science, Sante Fe, NM, USA, 18-20 May 1981)	
6	6:29659	*See* BNL-29512
CONF-810528-	(83. symposium on nucleation and crystallization in glasses, Washington, DC, USA, 3-6 May 1981)	
8	6:28199	*See* GA-A-16215
CONF-810539-	(Conference on the application of microprocessors to high energy physics experiments, Geneva, Switzerland, 4-6 May 1981)	
8	6:29183	*See* BNL-29675
CONF-810546-	(1981 spring DECUS U.S. symposium, Miami Beach, FL, USA, 18-21 May 1981)	
4	6:29737	NTIS, PC A02/MF A01. Order Number DE81025596, Distribution Category MN -32
CONF-810563-	(Adriatic europhysics study on nuclear physics dynamics of heavy-ion collisions conference, Croatis, Yugoslavia, 25-30 May 1981)	
2	6:29519	*See* LBL-12656
3	6:29517	*See* UCRL-86443
CONF-810566-	(International conference on fast ionic transport in solids, Gatlinburg, TN, USA, 18-22 May 1981)	
5	6:29017	*See* BNL-29725
6	6:29021	*See* SAND-81-0128C
CONF-810588-	(DOE/NBS workshop on environmental speciation and monitoring needs, Gaithersburg, MD, USA, 18-20 May 1981)	
2	6:29356	*See* LBL-12905
3	6:29063	*See* LBL-12625
CONF-810595-	(International symposium on intraocular tumors, Schwerin, German Democratic Republic, 17-21 May 1981)	
1	6:29317	*See* BNL-29670
CONF-810598-	(International magnetics conference, Grenoble, France, 12-15 May 1981)	
1	6:28318	*See* UNI-SA-80
CONF-8105103-	(16. symposium on electron ion and photo beam technology, Dallas, TX, USA, 26-29 May 1981)	
1	6:29713	*See* UCRL-85506
CONF-8105105-	(Symposium on electrocatalyis, Minneapolis, MN, USA, 10-15 May 1981)	
2	6:28842	*See* BNL-29788
CONF-810602-	(7. symposium on detonation, Annapolis, MD, USA, 19 Jun 1981)	
30	6:29201	*See* SAND-80-2438C
31	6:29199	*See* UCRL-85614
CONF-810606-	(American Nuclear Society's annual meeting, Miami Beach, FL, USA, 7-12 Jun 1981)	
57	6:28209	*See* HEDL-SA-2325-FP
65	6:28672	*See* HEDL-SA-2321-FP
75	6:28823	NTIS, PC A02/MF A01. Order Number DE81026013, Distribution Category MN -61a
78	6:29557	NTIS, PC A02/MF A01. Order Number DE81026526, Distribution Category MN -34C
79	6:28649	NTIS, PC A03/MF A01. Order Number DE81027222, Distribution Category MN -78
80	6:29660	NTIS, PC A02/MF A01. Order Number DE81026525, Distribution Category MN -20a
81	6:28264	NTIS, PC A02/MF A01. Order Number DE81027125, Distribution Category MN -70
82	6:29661	NTIS, PC A02/MF A01. Order Number DE81026524, Distribution Category MN -20d
83	6:28708	NTIS, PC A02/MF A01. Order Number DE81027113, Distribution Category MN -78
84	6:28728	NTIS, PC A02/MF A01. Order Number DE81027124, Distribution Category MN -78
CONF-810607-	(Symposium on instrumentation and control for fossil energy processes, San Francisco, CA, USA, 8-12 Jun 1981)	
11	6:28057	*See* LBL-12807
CONF-810613-	(Conference on lasers and electro-optics, Washington, DC, USA, 10-12 Jun 1981)	
7	6:29207	*See* BNL-28979
8	6:29682	*See* KMSF-U-1087
9	6:28342	*See* UCRL-85281
10(Rev.1)	6:28198	*See* UCRL-85175(Rev.1)
CONF-810620-	(4. international topical conference on high-power electron and ion-beam research and technology, Palaiseau, France, 29 Jun-3 Jul 1981)	
7	6:29141	*See* LA-UR-81-1936
8	6:29594	*See* LA-UR-81-1860
9	6:29687	*See* LA-UR-81-1873
11	6:29686	*See* LA-UR-81-1849
12	6:29705	*See* SAND-81-0672C
13	6:29714	*See* UCRL-85651
14	6:29165	*See* UCRL-85557
CONF-810622-	(8. ocean energy conference, Washington, DC, USA, 7-11 Jun 1981)	
6	6:28458	*See* LBL-12956
7	6:28459	*See* LBL-12963
CONF-810623-	(24. midwest symposium on circuits and systems, Albuquerque, NM, USA, 29-30 Jun 1981)	
10	6:29689	*See* LA-UR-81-1943
11	6:28440	*See* SAND-81-1717C
CONF-810624-	(22. US symposium on rock mechanics, Cambridge, MA, USA, 29 Jun-2 Jul 1981)	
10	6:28308	*See* RHO-BWI-SA-113
11	6:28167	*See* UCRL-85189
CONF-810625-	(ASME PVP conference, Denver, CO, USA, 21-26 Jun 1981)	
21	6:28663	NTIS, PC A03/MF A01. Order Number DE81027370, Distribution Category MN -79e
CONF-810642-	(4. DOE battery and electrochemical contractor's conference, Washington, DC, USA, 2-4 Jun 1981)	
5	6:28754	*See* LBL-12690
CONF-810643-	(1. international specialists meeting on BWR-pressure suppression containment technology, Geesthacht, F.R. Germany, 1-3 Jun 1981)	
1(Rev.1)	6:28739	*See* UCRL-85707Rev.1
CONF-810647-	(Conference on X- and gamma-ray sources and applications, Ann Arbor, MI, USA, 10-12 Jun 1981)	
7	6:28339	*See* KMSF-U-1097

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8	6:29299	*See* BNL-29737
9	6:29188	*See* EGG-M-01181
CONF-810649-	(4. international conference on nuclei far from stability, Helsignor, Denmark, 7-13 Jun 1981)	
7	6:29526	*See* LBL-12853
8	6:29524	*See* BNL-29694
10	6:29521	*See* BNL-29691
11	6:29522	*See* BNL-29692
12	6:29523	*See* BNL-29693
CONF-810659-	(3. IEEE international pulsed power conference, Albuquerque, NM, USA, 1-3 Jun 1981)	
13	6:29572	*See* LA-UR-81-1928
15	6:29684	*See* LA-UR-81-1671
16	6:29716	*See* UCRL-85720
18	6:29704	*See* SAND-81-0617C
20	6:29718	*See* UCRL-85760
24	6:29706	*See* SAND-81-0755C
25	6:29707	*See* SAND-81-1553C
26	6:29717	*See* UCRL-85721
27	6:29174	*See* SAND-81-1713C
CONF-810664-	(5. AIAA computational fluid dynamics conference, Palo Alto, CA, USA, 22-23 Jun 1981)	
2	6:29149	*See* LA-UR-81-1882
CONF-810667-	(Enlarged halden programme group meeting on process computer applications, Fredrikstad, Norway, 14-19 Jun 1981)	
1	6:28647	NTIS, PC A02/MF A01. Order Number DE81023194, Distribution Category MN -78
CONF-810668-	(Symposium on resonance ionization spectroscopy and its applications, Gatlinburg, TN, USA, 2 Jun 1981)	
1	6:29185	NTIS, PC A02/MF A01. Order Number DE81023193, Distribution Category MN -48
CONF-810672-	(DOE heat pump contractors' program integration meeting, McLean, VA, USA, 2-4 Jun 1981)	
1	6:28853	NTIS, PC A02/MF A01. Order Number DE81024965, Distribution Category MN -95
2	6:28854	NTIS, PC A02/MF A01. Order Number DE81023218, Distribution Category MN -95d
3	6:28855	NTIS, PC A02/MF A01. Order Number DE81024983, Distribution Category MN -95e
5	6:28856	NTIS, PC A02/MF A01. Order Number DE81024139, Distribution Category MN -95d
6	6:28857	NTIS, PC A02/MF A01. Order Number DE81024137, Distribution Category MN -95d
7	6:28858	NTIS, PC A02/MF A01. Order Number DE81024136, Distribution Category MN -95d
9	6:28859	NTIS, PC A02/MF A01. Order Number DE81024084, Distribution Category MN -95d
11	6:28860	NTIS, PC A02/MF A01. Order Number DE81024086, Distribution Category MN -95d
13	6:28861	NTIS, PC A02/MF A01. Order Number DE81024121, Distribution Category MN -95d
14	6:28862	NTIS, PC A02/MF A01. Order Number DE81024076, Distribution Category MN -95d
19	6:28863	NTIS, PC A02/MF A01. Order Number DE81024131, Distribution Category MN -95d
20	6:28864	NTIS, PC A02/MF A01. Order Number DE81024126, Distribution Category MN -95d
22	6:28745	*See* BNL-29592
CONF-810673-	(4. symposium on neutron dosimetry, Munich-Neuherberg, F.R. Germany, 1-5 Jun 1981)	
1	6:29320	NTIS, PC A02/MF A01. Order Number DE81023225, Distribution Category MN -41
2	6:29562	*See* LA-UR-81-1694
3	6:29300	*See* BNL-29783
CONF-810675-	(15. rare earth research conference, Rolla, MO, USA, 15-18 Jun 1981)	
2	6:29066	*See* RFP-3185
CONF-810676-	(2. joint US-USSR workshop on the health and environmental effects of oil shale development, Tallinn, USSR, 22-27 Jun 1981)	
2	6:29354	*See* LA-UR-81-1846
3	6:29355	*See* LA-UR-81-1847
4	6:28176	*See* LA-UR-81-1850
CONF-810679-	(Heat transfer and heat exchangers workshop, Vail, CO, USA, 18-19 Jun 1981)	
1	6:28523	NTIS, PC A02/MF A01. Order Number DE81023195, Distribution Category MN -66f
CONF-810680-	(Symposium on physics problems of fusion reactors, Trieste, Italy, 2-9 Jun 1981)	
1	6:29584	NTIS, PC A02/MF A01. Order Number DE81023219, Distribution Category MN -20f
2	6:29662	NTIS, PC A02/MF A01. Order Number DE81024254, Distribution Category MN -20a
CONF-810682-	(6. international conference: Modern trends in activation analysis, Toronto, Canada, 15-19 Jun 1981)	
7	6:29052	*See* UCRL-85365
8	6:29044	*See* BNL-29707
CONF-810684-	(APS conference on shock waves in condensed matter, Menlo Park, CA, USA, 23-25 Jun 1981)	
24	6:29202	*See* UCRL-86259
25	6:28988	*See* SAND-81-0022C
29	6:28960	*See* LA-UR-81-1897
34	6:29131	*See* LA-UR-81-1883
35	6:29083	*See* SAND-81-1353C
36	6:29569	*See* SAND-81-1194C
37	6:29567	*See* LA-UR-81-1782
38	6:28168	*See* UCRL-86283
39	6:28959	*See* LA-UR-81-1768
41	6:29701	*See* SAND-80-2870C
CONF-810694-	(25. Wind River conference on genetic exchange, Estes Park, CO, USA, 8-12 Jun 1981)	
1	6:29321	NTIS, PC A02/MF A01. Order Number DE81024140, Distribution Category MN -48
2	6:29293	*See* BNL-29730
CONF-810698-	(International symposium on rock mechanics related to caverns and pressure shafts, Bundesrepublik, Deutschland, F.R. Germany, 26-28 Jun 1981)	
1	6:28314	*See* SAND-81-1167C
CONF-810699-	(Society of Women Engineers 1981 national convention, Anaheim, CA, USA, 24-28 Jun 1981)	
1	6:29663	NTIS, PC A02/MF A01. Order Number DE81024129, Distribution Category MN -20
CONF-8106100-	(International conference on laser spectroscopy, Alberta, Canada, 29 Jun-3 Jul 1981)	
2	6:29417	*See* SAND-81-1589C
3	6:29568	*See* LBL-12930
CONF-8106101-	(Symposium on energy and environment, turbomachinery technology, Patras, Greece, 22-26 Jun 1981)	
1	6:29125	NTIS, PC A03/MF A01. Order Number DE81024075, Distribution Category MN -38
CONF-8106102-	(Conference on characterization and quality control of nuclear fuels, Karlsruhe, F.R. Germany, 2-5 Jun 1981)	
1	6:28698	*See* LA-UR-81-1662
CONF-8106105-	(International conference on internal friction and acoustic attenuation of solids, Lausanne, Switzerland, Jun 1981)	
2	6:28944	*See* DOE/ER/01198-1356
CONF-8106108-	(Low energy X-ray conference, Monterey, CA, USA, Jun 1981)	
2	6:29593	*See* LA-UR-81-1711
CONF-8106109-	(Workshop on processing needs and methodology for wastewaters from the conversion of coal, oil shale and biomass to synfuels, Germantown, MD, USA, Jun 1981)	
2	6:28177	*See* LA-UR-81-1903
CONF-8106112-	(Workshop on pulsating B stars, Nice, France, 1-5 Jun 1981)	
1	6:29379	*See* LA-UR-81-1907
2	6:29380	*See* LA-UR-81-1908
CONF-8106113-	(22. AESOP meeting, Idaho Falls, ID, USA, 15-18 Jun 1981)	
1	6:28335	*See* SAND-81-1498C

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CONF-8106115-		(US/FRG bilateral meeting, Bonn, F.R. Germany, 8-12 Jun 1981)
1	6:28316	*See* SAND-81-1204C
CONF-8106116-		(Workshop on maximum entropy estimation and data analysis, Laramie, WY, USA, 8-10 Jun 1981)
1	6:29592	*See* LA-UR-81-1697
CONF-8106120-		(5. meeting of the international collaboration on advanced neutron sources, Julich, F.R. Germany, 22-26 Jun 1981)
3	6:29179	*See* LA-UR-81-1851
4	6:29691	*See* LBL-12855
CONF-8106122-		(National fuel cell seminar, Norfolk, VA, USA, 23-25 Jun 1981)
(Absts.)	6:28843	NTIS, PC A08/MF A01. Order Number DE81026688, Distribution Category MN -93
CONF-8106123-		(Union Carbide Corporation medical director's meeting, Chicago, IL, USA, 22-15 Jun 1981)
1	6:29365	NTIS, PC A02/MF A01. Order Number DE81024132, Distribution Category MN -41
CONF-8106124-		(Civil engineering department seminar, Seattle, WA, USA, 1 Jun 1981)
1	6:28208	*See* RHO-SA-223
CONF-8106125-		(Shock compression of solids conference, Stanford, CA, USA, 23-25 Jun 1981)
1	6:28989	*See* SAND-81-0070C
CONF-8106131-		(5. actinide separations workshop, Argonne, IL, USA, 11-12 Jun 1981)
1	6:29050	*See* RFP-3237
CONF-810701-		(Computer simulation conference, Washington, DC, USA, 15-17 Jul 1981)
5	6:29236	NTIS, PC A02/MF A01. Order Number DE81026519, Distribution Category MN -11
6	6:28087	NTIS, PC A02/MF A01. Order Number DE81025632, Distribution Category MN -86
CONF-810705-		(16. annual conference of the Microbeam Analysis Society, Vail, CO, USA, 13-17 Jul 1981)
4	6:29003	NTIS, PC A02/MF A01. Order Number DE81027134, Distribution Category MN -25
5	6:29051	*See* SAND-81-1395C
6	6:29196	*See* RFP-3188
CONF-810706-		(Institute of Nuclear Materials Management conference, San Francisco, CA, USA, 13 Jul 1981)
9	6:28331	*See* LA-UR-81-1978
17	6:29049	*See* LA-UR-81-1966
19	6:28333	*See* SAND-81-0594C
20	6:28334	*See* SAND-81-1469C
21	6:28202	NTIS, PC A02/MF A01. Order Number DE81026326, Distribution Category MN -78
22	6:28327	NTIS, PC A02/MF A01. Order Number DE81025656, Distribution Category MN -15
24(Draft)	6:28328	NTIS, PC A02/MF A01. Order Number DE81025620, Distribution Category MN -15
25	6:28326	*See* AGNS-35900-CONF-128
28	6:28332	*See* LA-UR-81-2178
CONF-810707-		(IEEE conference on nuclear science and space radiation, Seattle, WA, USA, 21-24 Jul 1981)
5	6:29190	*See* SAND-81-0451C
CONF-810718-		(Annual heavy oil/EOR contractor report meeting, San Francisco, CA, USA, 27-31 Jul 1981)
	6:28157	NTIS, PC A12/MF A01. Order Number DE81027072, Distribution Category STD -92a
CONF-810720-		(2. international swarm seminar, Oak Ridge, TN, USA, 22-23 Jul 1981)
3	6:29092	NTIS, PC A02/MF A01. Order Number DE81026352, Distribution Category MN -34A
CONF-810722-		(International symposium on migration in the terrestrial environment of long-lived radionuclides from the nuclear fuel cycle, Knoxville, TN, USA, 27-31 Jul 1981)
2	6:28311	*See* RHO-SA-213
3	6:28265	NTIS, PC A02/MF A01. Order Number DE81026520, Distribution Category MN -70
4	6:29249	*See* IAEA-SM-257/41
5	6:29248	NTIS, PC A02/MF A01. Order Number DE81026522, Distribution Category MN -41
6	6:28324	*See* RHO-SA-211
CONF-810724-		(AIAA/SAE/ASME joint propulsion conference, Colorado Springs, CO, USA, 27-29 Jul 1981)
1	6:29195	*See* LA-UR-81-1748
CONF-810726-		(9. international conference on operational research, Hamburg, F.R. Germany, 23 Jul 1981)
1	6:28817	*See* BNL-29748
CONF-810728-		(9. international conference on atomic collisions in solids, Lyon, France, 6-10 Jul 1981)
1	6:29416	*See* SAND-81-0850C
2	6:29410	NTIS, PC A03/MF A01. Order Number DE81025187, Distribution Category MN -34
3(Draft)	6:29411	NTIS, PC A02/MF A01. Order Number DE81025178, Distribution Category MN -34A
CONF-810729-		(15. international conference on phenomena in ionized gases, Minsk, USSR, 14-16 Jul 1981)
1	6:29623	*See* UCRL-85970
CONF-810730-		(1981 national conference on environmental engineering, Atlanta, GA, USA, 8-10 Jul 1981)
1	6:29221	NTIS, PC A02/MF A01. Order Number DE81025172, Distribution Category MN -41
CONF-810732-		(Seminar on recent theoretical (computational) developments in atomic collisions in soilds, Strasbourg, France, 14-16 Jul 1981)
1	6:29412	NTIS, PC A03/MF A01. Order Number DE81025188, Distribution Category MN -34
CONF-810735-		(Albuquerque Home Builders Association meeting, Albuquerque, NM, USA, 23 Jul 1981)
1	6:28758	*See* SAND-81-1750C
CONF-810736-		(Meeting on glass structures: surface and bulk, University Park, PA, USA, 28-31 Jul 1981)
1	6:28278	*See* DP-MS-81-25
2	6:29022	*See* UCRL-85776
CONF-810801-		(6. international conference on structural mechanics in reactor technology, Paris, France, 17-21 Aug 1981)
9	6:29216	*See* UCRL-85459
48	6:28664	NTIS, PC A02/MF A01. Distribution Category MN -79k
CONF-810803-		(Topical meeting on reactor safety aspects of fuel behavior, Sun Valley, ID, USA, 2-6 Aug 1981)
8	6:28738	*See* SAND-81-1533C
CONF-810805-		(SIGGRAPH'81 meeting, Dallas, TX, USA, 3-7 Aug 1981)
6	6:29763	*See* LBL-12492
CONF-810808-		(Energy in the man-built environment: the next decade specialty conference, Vail, CO, USA, 3-5 Aug 1981)
2	6:28343	*See* BNL-29281
8	6:28534	*See* SERI/TP-634-1195
9	6:28447	*See* SERI/TP-632-1287
CONF-810809-		(16. international conference on low temperature physics, Los Angeles, CA, USA, 19-25 Aug 1981)
13	6:29006	*See* IS-M-331
CONF-810810-		(SPIE international symposium, San Diego, CA, USA, 24-28 Aug 1981)
14	6:29023	*See* UCRL-86513
18	6:29203	*See* LA-UR-81-2136
CONF-810811-		(Electron microscopy Society of America meeting, Atlanta, GA, USA, 13-17 Aug 1981)
1	6:28961	*See* LBL-12289
CONF-810812-		(IECEC conference, Atlanta, GA, USA, 9-14 Aug 1981)
25	6:28852	*See* BNL-29625
28	6:28505	NTIS, PC A02/MF A01. Order Number DE81025511, Distribution Category MN -66b
30	6:28338	*See* DOE/DP/40083-9
31	6:28931	NTIS, PC A02/MF A01. Order Number DE81025976, Distribution Category MN -96
CONF-810813-		(National American Chemical Society summer meeting, New York, NY, USA, 23-28 Aug 1981)
9	6:29105	*See* DP-MS-81-17

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CONF-810814-		(91. national meeting of the American Institute of Chemical Engineers, Detroit, MI, USA, 16-19 Aug 1981)
3	6:28764	NTIS, PC A03/MF A01. Order Number DE81026090, Distribution Category MN -41
4	6:28927	*See* DOE/NASA/51044-20
CONF-810824-		(10. international conference on organometallic chemistry, Toronto, Ontario, Canada, 9-14 Aug 1981)
1	6:29064	*See* LBL-12871
CONF-810828-		(Conference on high pressure physics, Bad Honnef, F.R. Germany, Aug 1981)
1	6:29018	*See* DOE/ER/01198-1359
CONF-810831-		(Fusion reactor materials meeting, Seattle, WA, USA, 9-12 Aug 1981)
1	6:29676	*See* DP-MS-80-130
2	6:29703	*See* SAND-81-0295C
3	6:29176	*See* UCRL-85429
4	6:29712	*See* UCRL-85452
5	6:29702	*See* SAND-81-0270C
CONF-810832-		(DOE passive and hybrid solar energy program update, Washington, DC, USA, 9-12 Aug 1981)
1	6:28479	*See* LA-UR-81-2185
2	6:28478	*See* LA-UR-81-2162
3	6:28477	*See* LA-UR-81-2102
CONF-810833-		(Mechanical, magnetic, and underground energy storage 1981 annual contractors' review meeting, Washington, DC, USA, 24-26 Aug 1981)
1	6:28743	*See* UCRL-86297
2	6:28932	*See* LA-UR-81-2177
CONF-810834-		(12. JANNAF propellant characterization meeting, Colorado Springs, CO, USA, 18-20 Aug 1981)
1	6:29053	*See* UCRL-85597
CONF-810901-		(EUROGRAPHICS '81 conference, Darmstadt, F.R. Germany, 9-11 Sep 1981)
1	6:29754	*See* LA-UR-81-45
CONF-810902-		(Heat pipe conference, London, UK, 7-10 Sep 1981)
1	6:29128	*See* LA-UR-81-909
2	6:28677	*See* LA-UR-81-1025
3	6:29129	*See* LA-UR-81-969
4	6:29130	*See* LA-UR-81-1414
CONF-810903-		(IEEE/PES conference, Minneapolis, MN, USA, 20-25 Sep 1981)
1	6:28640	*See* BNL-29291
CONF-810904-		(3. annual conference of the IEEE Engineering in Medicine and Biology Society, Houston, TX, USA, 19-20 Sep 1981)
1	6:29303	*See* SAND-81-0840C
CONF-810905-		(ANS/ENS topical meeting on probabilistic risk assessment, Post Chester, NY, USA, 20-24 Sep 1981)
3	6:28315	*See* SAND-81-1174C
CONF-810906-		(10. European conference on controlled fusion and plasma physics, Moscow, USSR, 14-19 Sep 1981)
1	6:29719	*See* UCRL-85867
2	6:29622	*See* UCRL-85883
3	6:29679	*See* GA-A-16307
5	6:29585	NTIS, PC A02/MF A01. Order Number DE81025050, Distribution Category MN -20a
CONF-810908-		(Symposium on VLSI technology, Maui, HI, USA, 9-11 Sep 1981)
1	6:29156	*See* SAND-81-1087C
CONF-810909-		(Institute of Gas Research conference, Los Angeles, CA, USA, 28 Sep-1 Oct 1981)
1	6:28061	*See* UCRL-85173
2	6:29243	*See* UCRL-85468
3	6:28166	*See* SAND-81-1399C
CONF-810910-		(7. international conference on high energy rate fabrication, Leeds, UK, 15-18 Sep 1981)
1	6:29007	*See* UCRL-85274
CONF-810911-		(Oceans 1981 conference, Boston, MA, USA, 16-18 Sep 1981)
1	6:29374	*See* SAND-81-0773C
CONF-810912-		(Active contractors' review meeting, Washington, DC, USA, Sep 1981)
2	6:28499	*See* MLM-2830(OP)
3	6:28461	*See* BNL-29678
4	6:28493	*See* BNL-29680
5	6:28488	*See* SERI/TP-632-1253
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4	6:28941	*See* BNL-29672
6	6:28923	*See* DOE/NASA/51040-29
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2	6:28060	*See* SAND-81-0138C
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1	6:29062	*See* IS-M-314
CONF-810920-		(4. international symposium on neutron-capture gamma-ray spectroscopy and related topics, Grenoble, France, 7-11 Sep 1981)
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6	6:29531	*See* BNL-29810
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3	6:28095	*See* UCRL-85880
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